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W. A. HARDENBERGH and A. PRESCOTT FOLWELL
Editors

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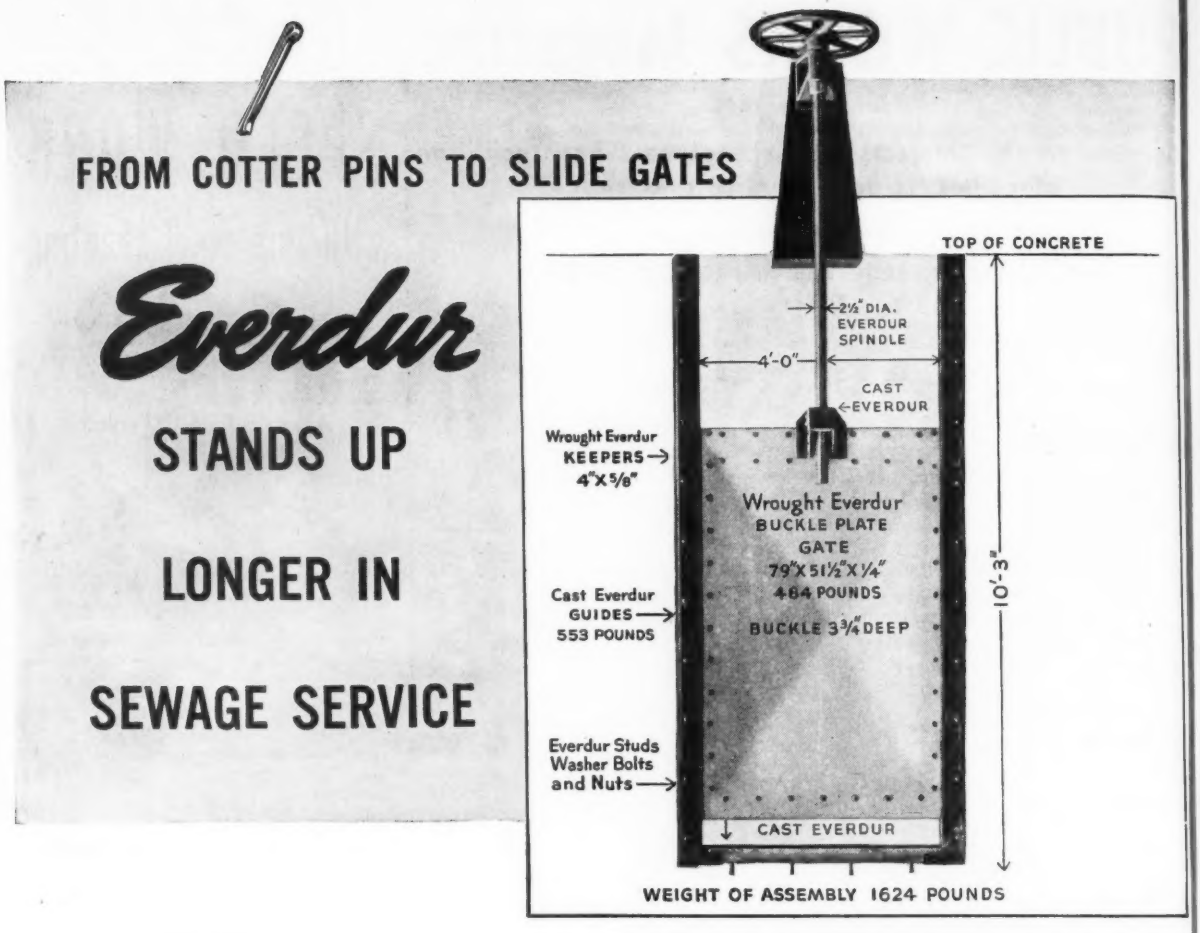

One of the five 13-year-old shut-off gates of Everdur Metal in the screen room of the Rahway Valley Joint Meeting Sewage Treatment Plant.

FOR 20 years Everdur* Copper-Silicon Alloys have performed well under the corrosive conditions imposed on sewage treatment equipment. These alloys have unusual resistance to corrosion. In addition, they provide high strength and, according to type, may be cast, hot or cold rolled, drawn, spun, forged or welded.

A good example of Everdur advantages is seen in the five shut-off gates in the screen room at Rahway, N. J., installed more than 13 years ago. These gates, which operate smoothly and easily by hand, weigh 1624 lbs., while cast, electrically-driven gates for the same service would have weighed well over four tons each!

In view of the fact that sewage service must not fail, a cotter pin may be as essential as the most massive equipment. Thus, Everdur Metal has been more and more widely specified for such uses as:

Coarse and Fine Screens
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The Editor's Page

Greetings for 1948

When this appears, our readers will have entered on another year, and we wish for them that it will be a prosperous and pleasant year; and that it will be a year when they will have a bit of that prewar leisure it is so nice to think back on. The past seven years have been difficult ones for all, but to many they have brought some compensations of service, usefulness to our country and advancement.

To the many hundreds who have remembered the editor with holiday greetings, he sends his best and heartfelt regards. It has not been possible to answer each and every one of these individually, pleasant as it would have been to do so. To the thousands of young men who served with him, and to the other thousands who did not serve but contributed their full share in making it possible for our armies to fight effectively in disease-ridden areas, the editor owes a special debt which can not be expressed in words. To them he can say only that the resources available to him or to PUBLIC WORKS are available to them.

On our part we hope to make PUBLIC WORKS more useful and more valuable to all, but especially to the younger men. We have plans for the coming year that we think will accomplish this desired end, but we shall let their fulfillment determine how successful we have been.

So, as we start on 1948, we wish the fullest measure of happiness, pleasure and success to all.

Post War Training for Sanitary Corps Officers

There is before the Editor an announcement regarding "Inactive Duty Training" and it refers to all officers assigned to certain medical units in New York City, including some 50 or 60 former Sanitary Corps officers. The subject of this attractive lecture is "Problems in Surgery" and it will no doubt be of great benefit and interest to sanitary engineers, entomologists and scientists in like fields. This Editor has written to the Army Senior Reserve Instructor for the New York area on this general subject, pointing out that these former Sanitary Corps officers were fully capable of planning and carrying on a training program of a suitable nature and adapted to their needs, but no reply has been received. It appears that no account is to be taken of our lessons in preventive medicine, learned at great cost in the recent war, and that what is good enough for the medics is precisely what everyone else assigned to the Medical Department needs.

More Trouble for the Sewage Plant Operator?

Newspapers have been reporting the troubles of a small Pennsylvania sewage plant after every home received a free sample of a new "soapless soap." Next morning suds were overflowing the primary settling tank and the aeration basin, and cascading onto the surrounding lawn. The diagnosis was that this detergent dissolved the deposits on the inside of the sewers. No serious harm was done, but it is interesting to speculate on the effect, if any, on sewage treatment plants and processes of the wholesale use of the many new detergents now being put on the market. These are much more effective than soap. Remembering the problems created some years ago by the increasing use of cellulose products, we will be interested to hear more from operators who have given this matter thought or have had experiences or carried on experiments with the new detergents.

The Army Affiliation Program

In order to provide the service units that will be needed in case of another emergency, the Army is putting on a campaign for the formation of "affiliated units." These are organized generally by a corporation or a department serving a special technical field; for instance, a state highway department might form a construction battalion, or a road building or maintenance battalion; a water department, a water purification unit; etc. This plan is an excellent one, but there are some problems to which attention ought to be given.

In the first place, as we have said many times previously, there is going to be a shortage of engineers in another emergency. Ordinarly in a service unit of this type, only about one-third of the officers need to be qualified engineers. There is great likelihood that the peace-time organization will provide that all officers be technically qualified. When an emergency comes, these units will go into service almost at once, staffed to an unnecessary extent with high-grade men. When other units must be built up, there will be a shortage of qualified men to fill even the key positions in them.

A difficulty with similar affiliated units in World War II was that promotion was very slow. The table of organization was filled initially, and promotion was possible only when rare transfers or casualities occurred. The man in the affiliated unit often stayed a captain while his associates in civil life went on to silver leaves. Provisions to correct this inequity must be made.

These are among the important factors to be considered if these important service organizations are to be of maximum value.

Off-Street Parking

A place to park is essential to every section of every community. If privately operated facilities cannot provide for the real needs of the citizens, the municipality must then step in. If parking meters do not solve the problem and there are not enough parking spaces on the streets—due regard being given to traffic safety—the municipality should provide off-street parking areas. This is as much a public function as paving of streets or furnishing water, sewerage and refuse collection service. Parking lots should not be located haphazardly, as on land which has no other use. The municipality should look for off-street parking areas that will be of maximum benefit to the citizens of the community. It must be within reasonable distance of shopping centers. Interior-block areas and land already owned by the community would be good places to start.

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FROM OUR READERS

From the Orient:

GENTLEMEN:

We have received a great deal of U. S. Army and Navy surplus road construction equipments from UNRRA. I am hoping to get some information of it, and very appreciate your "The Highway, Street and Airport Manual." Please send me one near copy to the following address. Thanking you in advance for this favor, I am,

TAI CHEN-FAN
First Engineering Force, China

Too Late:

GENTLEMEN:

Please quote price for 750 copies of reprint of the article regarding the City of Hearne, Texas, which appeared in your November issue. These reprints will be used for circulation locally.

W. A. ROBERTSON, Texas

Ed. Note: We are sorry; type is held only briefly after an issue appears, and requests for reprints must be received within 10 days after publication. We suggest wiring in cases such as the above.

This Makes Us Blush:

GENTLEMEN:

In your September issue there is an article on page 33 on "How to Design Imhoff Tanks and Trickling Filters for Schools, Camps and Hotels." My issue having been taken from my office, due to its great popularity, I would greatly appreciate your sending me all further information available on the subject.

E. J. FOSTER
County Engineer, Texas

Ed. Note: Another copy was sent Mr. Foster; and in the near future, PUBLIC WORKS will begin publication of a series of articles on small sewage treatment plant equipment and design.

Cleaning Sludge Lagoons:

GENTLEMEN:

Thanks for your letter regarding equipment for emptying lagoons. Considering how little I told you of my problem, the answer was very helpful. Emptying our sludge lagoons has been a problem here in Fort Wayne. We have to take our crane right into the lagoon and load on trucks. The crane, 18 tons, is far too heavy for the some-

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***BONUS:** "Something given in addition to what is usual or strictly due."— Webster's Dictionary*

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what spongy bottom, and it has to be supported on mats which slows the work considerably. However, the big difficulty has been with rubber-tired trucks. They skid terribly on the moist sludge. Right now my thought is to get an overhead loader on treads and use trucks on treads. Your suggestion about a cableway is one that I have long had in mind. However, our lagoons are boxed in with a railroad on one side and a high bank on the other so that outside crane work is impossible. If I were designing new lagoons I would certainly give serious consideration to your suggestion. Just the same, I shall write to the companies you mentioned—you never know where questions lead to and sometimes there is an unexpected solution to a problem.

RALPH A. HOOT, Indiana

Cross-Connections and Safe Water:

DEAR SIR:

We wish to express our appreciation and commendation for the very fine article on "Water-Borne Disease Outbreaks" which appeared in your November, 1947, issue of PUBLIC WORKS. . . . We feel that the facts presented in this article . . . will be of considerable help to other agencies and municipalities in their fight to control and eliminate cross-connections and other sources of water-borne diseases. It is our hope that in future issues, we can have more of this kind of data on this most important subject.

H. B. PEARCE
Clayton Mfg. Co.

Training Data:

GENTLEMEN:

I should greatly appreciate a copy of your January, 1947, issue. I am especially interested in the "Easy to Use On-the-Job Training Program for your Highway Personnel." . . .

L. G. HARVEY, Massachusetts

More on Small Plants:

Dear Sir:

Reference is made to your article "How to Design Imhoff Tanks and Trickling Filters for Schools, Camps, and Hotels," contained in the September, 1947, issue of PUBLIC WORKS.

Contained therein under "Trickling Filters" is an offer by you to forward data on request, covering small rotary and fixed nozzle distributors. It is requested that a copy of such data be forwarded to the writer, if available.

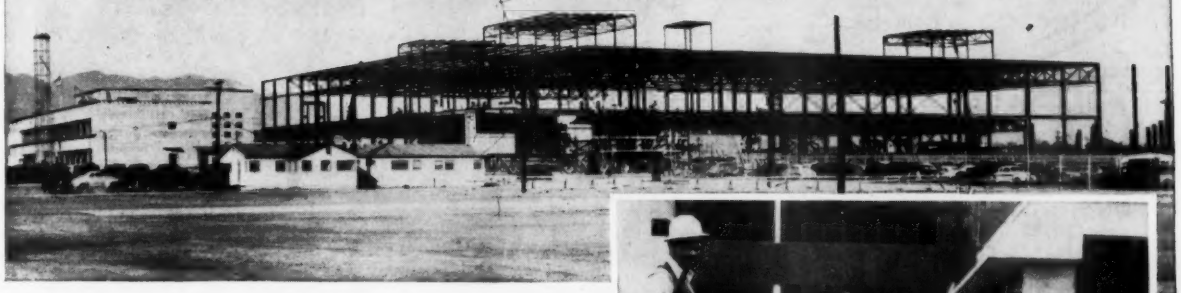
Would also appreciate receiving any recommendations you may care to make, of books, literature, etc., which cover the design, construction and maintenance of small sewage disposal installations for populations of fifty (50) to two thousand (2,000) persons.

Very truly yours,
MARTIN J. CULLITY
Engineer

VITRIFIED CLAY PIPE

Handles Tough Assignment

For New G. M. Plant's Sanitary Sewer System



VITRIFIED CLAY PIPE was used exclusively for the sanitary sewer system of General Motor's new $7,500,000 assembly and distributing plant 1½ miles north of Van Nuys, California. Clay Pipe was specified because it is the *only* pipe impervious to the corrosive action and acidity of the industrial wastes to be drained off through the sewer system.

In some places the sewer trenches ranged from 12 feet to 22 feet in depth to get the required fall. The soil is very sandy and subject to seismic conditions. The sewer system runs under railway tracks and roadways where it is subject to extra heavy loads. In these installations, Extra-Strength Clay Pipe was used.

On *any* industrial sewer line installation, it pays to specify Clay Pipe. If you need specific information on Clay Pipe, write the office nearest you.

Eight thousand feet of Vitrified Clay Pipe was used in constructing the new General Motors sanitary sewer system and connecting it with the Los Angeles sewer system. Where extra-heavy loads were encountered, Extra-Strength Clay Pipe was specified. Donald Parkinson of Los Angeles was the architect. The E-L-E Company of Los Angeles were consulting engineers. E. Willardson, Plumbing and Heating Contractor, also of Los Angeles, installed the Clay Pipe. Superintendent on the job was Walter A. Moss.

★ ★ ★

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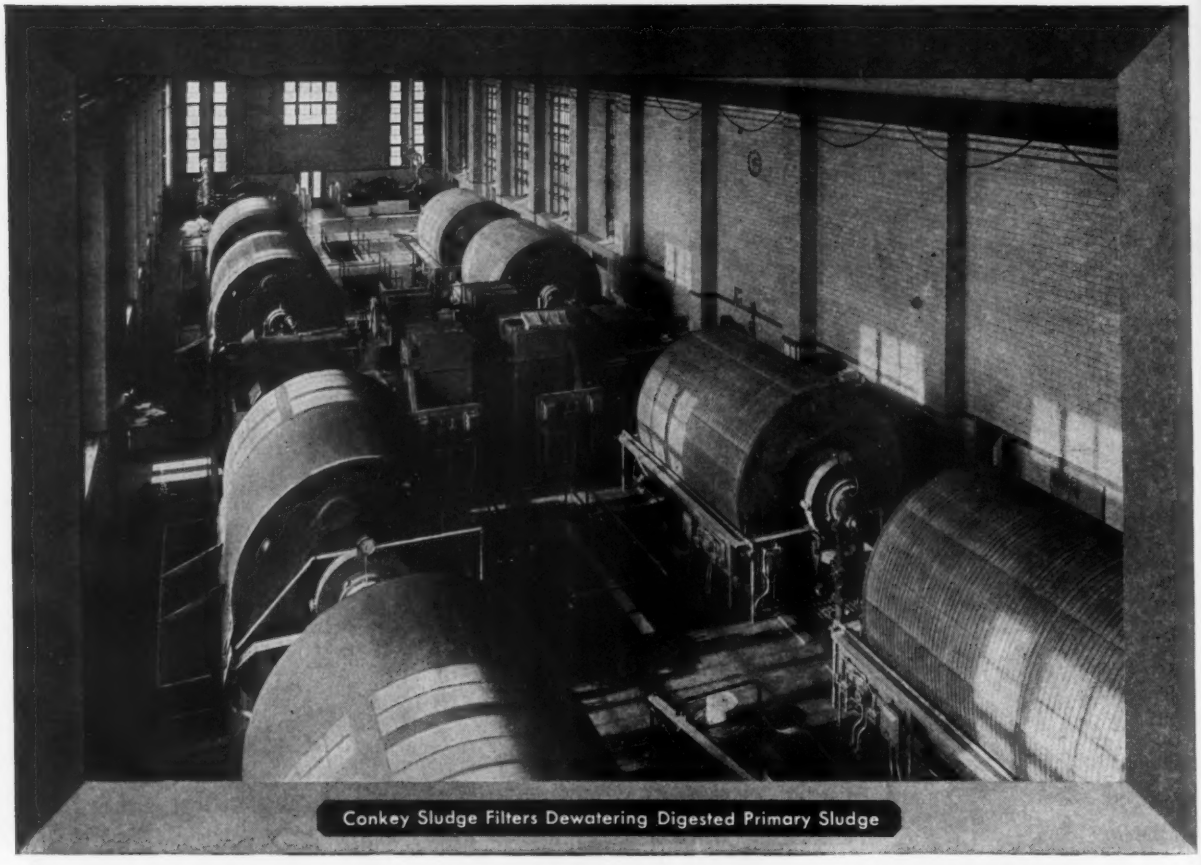

Conkey Sludge Filters Dewatering Digested Primary Sludge

The Background Began in 1872

The dewatering of sewage sludge in the past was one of the most difficult problems in sewage disposal —so much so that the first rotary drum vacuum filter on record was devised for that field. This patent was taken out in London in 1872 and entitled "an improved apparatus for drying sewage precipitates, cement, paper pulp and other fluid or semi-fluid matter."

It was not until 1915 however, that continuous filtration was successfully attempted with the installation of the "Zenith" rotary drum vacuum filter (forerunner of the CONKEY) for the dewatering of Imhoff sludge.

Today the Conkey Sludge Filter design incorporates the knowledge and experience gained through the continuous designing, constructing, installing and servicing of filters for dewatering sludges since 1915.

When considering increasing present sewage sludge dewatering facilities, or designing new plants for the future, consult General American. You will receive the benefit of experienced engineers with a correct understanding of vital factors such as feed consistency, conditioning of chemicals, conditioning time, application and mixing, as well as the all important knowledge of actual filter construction.

Write for a copy of Bulletin No. 100 which gives more information on this filter.

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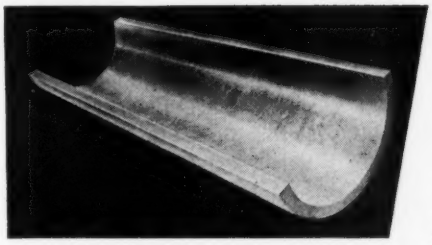
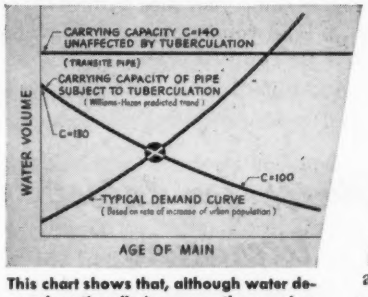
"Plenty of 'fire-flow' here!"

...says the Testing Crew



Transite's smooth interior is permanently unaffected by the destructive effects of tuberculation. Its high carrying capacity *stays high*.



This chart shows that, although water demand continually increases, the carrying capacity of water mains subject to tuberculation progressively decreases. Note the much longer period during which a Transite line, represented by the straight curve, continues to meet demands.

TESTS such as those made periodically by the fire insurance underwriters emphasize the fact that the most effective fire protection is provided by the water pipe with a *maintained* high carrying capacity.

Transite Pressure Pipe has this important advantage. It has an unusually high flow coefficient (C=140) . . . a coefficient which stays high because Transite, being made of asbestos and cement, is completely immune to tuberculation. This troublesome form of internal corrosion can never reduce Transite's initial high carrying capacity.

This means that a Transite water line helps assure the required flow of water for fire-fighting needs. It means that pumping costs can be held to a minimum. And it means that taxpayers can receive the benefits of the favorable fire insurance rates which result from a modern, efficient water distribution system.

The assurance of a maintained high carrying capacity is one of many reasons why it will pay you to investigate Transite Pressure Pipe when you plan water works improvements. Transite's proved resistance to corrosive soils . . . its tight, flexible joints that safeguard against underground leakage . . . its maintained strength and continued low maintenance are other advantages you will want to know more about in connection with your water works projects.

To get all the facts write for brochure TR-11A. Address Johns-Manville, Box 290, New York 16, N. Y.

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Easy to inspect — self-locking thread on the back head and snap-in key on packing retainer permits easy assembly, disassembly, and packing adjustment. Butt, firmly held by a straight splined taper on the piston rod, can be quickly removed.

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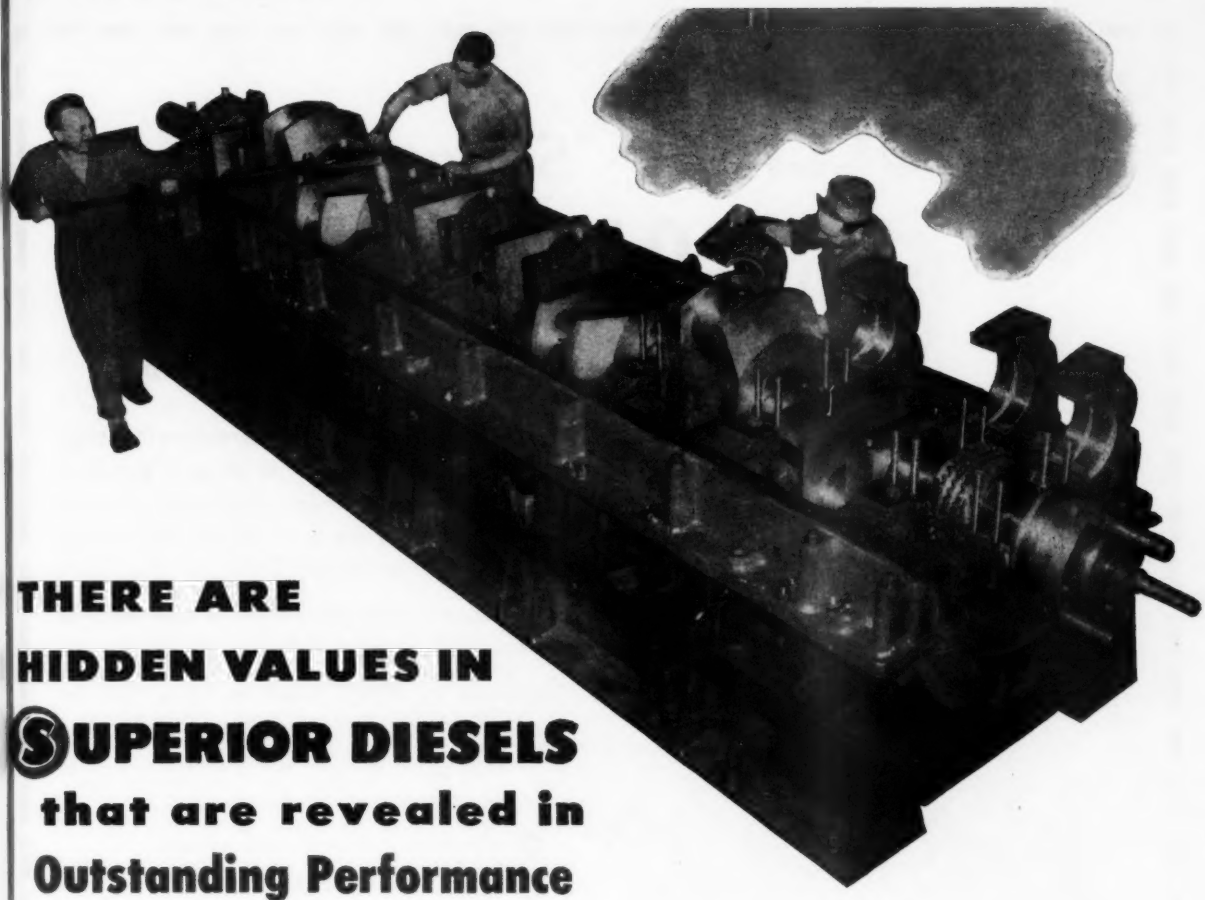

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Bearing supports are bored in line to close tolerances. This permits the use of precision bearing shells for the crankshaft journal and eliminates shimming for bearing clearances. The desirability of this feature has been proved for many years in automotive engine practice. It provides a valuable maintenance advantage because parts fit exactly . . . slip into place easily . . . and there are no delays or errors caused by outmoded cut and try methods.

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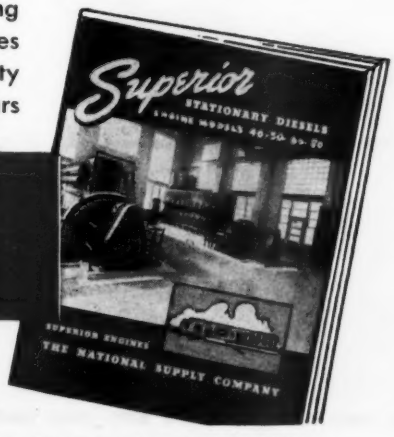

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A new 28 page booklet, "Superior Stationary Diesel Engines" is just off the press. It's packed with facts that tell *how, when and why* Superior Diesel Engines can help you build profits. Write for your free copy today.

When writing, we will appreciate your mentioning PUBLIC WORKS

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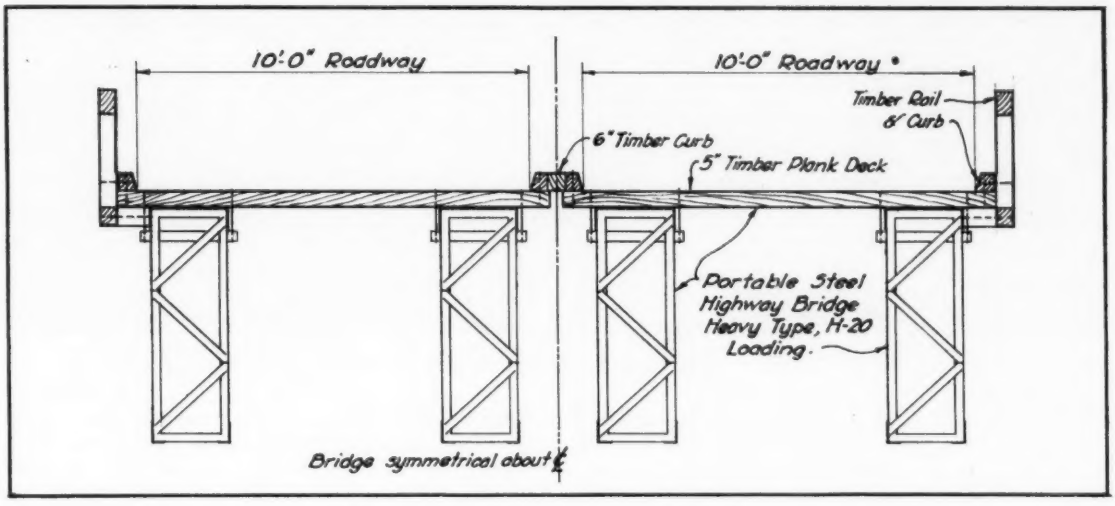


Fig. 3. Section of 2-lane bridge across Big Sur River.

USING WAR SURPLUS BRIDGES

How the California Highway Department has utilized Bailey truss bridges on rural highways.

H. D. STOVER

Senior Bridge Engineer, California Division of Highways

THE State of California has found it economical to use surplus United States Army, portable steel highway bridges, fixed type, in permanent structures. To date one such bridge has been completed and a second is under contract.

Figs. 1 and 2 illustrate the completed Mill Crossing bridge on a service road across Lagunitas Creek in Samuel P. Taylor State Park. The main span is an H-10 bridge 72 feet long, consisting of two structural steel box girders, made up of light angles welded to subdivided Warren trusses, and a timber deck. The girders were furnished in sections 12 feet long; the sections being bolted together with 1¼-inch bolts having a minimum yield point of 40,000 pounds per square inch. When assembled, the bridge has a truss depth of 4 feet and provides a single 10-foot clear roadway.

As built for the Army these bridges do not have railings. A steel railing was provided, consisting of a 6" x 4" x ⅜" angle top rail and a 4-inch 5.4-pound channel intermediate rail supported on U frames made up of 6-inch, 12.5-pound I-beams. The U frames were reinforced at the corners by ½" gusset plates and were welded to the top chords of the trusses.

Nailing strips were bolted to the top chords of the trusses and the 3-inch deck planks were nailed to them with two 5½" x 5/16" double grip spikes. The bolts connecting the lower chords of the girder sections were reinforced by welding a 3" x ½" x 1'8" plate across the joint.

Another bridge is now under construction across Big Sur River in Pfeiffer Redwood State Park. This bridge, shown in cross-section in Fig. 3, consists of two parallel, heavy-type H-20 bridges 125' long with two 12-ft. ramps, making a total length of bridge of 149 ft. and providing a two-lane divided highway with 10-ft. clear roadways. The twin superstructure is supported on concrete piers and abutments. Each bridge is composed of two 2'0" x 6'0" steel box girders built in sections 12'6" long, in which the trusses are of the double Warren type.

The girders are supported 12'6" from each end, to give a 100-ft. main span. The overhangs, plus the

Fig. 2. Head-on view of Lagunitas Creek bridge.

Fig. 1. Another view of the Lagunitas Creek bridge.

ramps, form the 24.5-ft. end spans. The launching rollers, furnished with the bridge, were modified to provide the bearing assemblies at the ends of the main span. This method of supporting the girders shortened the span and reduced the stresses in the lower chords so that it was not necessary to reinforce the bolted connections, as was done at Lagunitas Creek.

The deck planks were laid directly on the upper chords of the trusses and held in place by nailing each plank to the wheel guard with one ⅜" x 9" spike and bolting to the trusses at approximately 6-ft. centers, using the deck clamping beams furnished with the bridge. A timber rail, adzed to give it a rustic appearance, was bolted to the outside wheel guards.

The Mill Crossing Bridge over Lagunitas Creek was so named because it is located at the site of a bridge built by Marin County in 1862 to provide better access to a paper mill. The only remaining portion of this early day bridge is the steel cylinder pier shown at the left in Fig. 1. This pioneer paper mill, the first on the Pacific Coast, was built in 1856 by Samuel P. Taylor.—*In cooperation with California Highways and Public Works.*

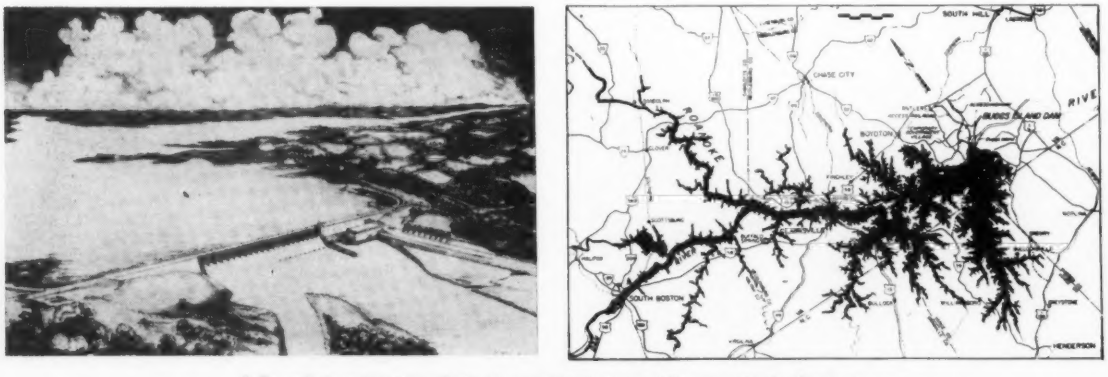
Roanoke River Development Program

Bids for construction are being called on the Buggs Island project, the first in a series of reservoirs planned for the development of the Roanoke River Basin. The dam will be 2800 ft. long, with a maximum height of 144 ft. The following are among the major items of work which will be required: Construction and removal of cofferdams; 98,000 cubic yards of common excavation; 108,000 cubic yards of rock excavation; 28,800 lineal feet of line drilling; preparation of 307,000 square feet of foundation; 100,000 cubic yards of quarrying stripping; drilling 33,100 lineal feet of holes; 10,000 bags of grout applied under pressure; approximately 600,000 cubic yards of concrete, 5,587,000 pounds of reinforcing steel; and 3,266,000 pounds of structural steel, miscellaneous steel and iron, and penstocks. The work is under direction of the Corps of Engineers.

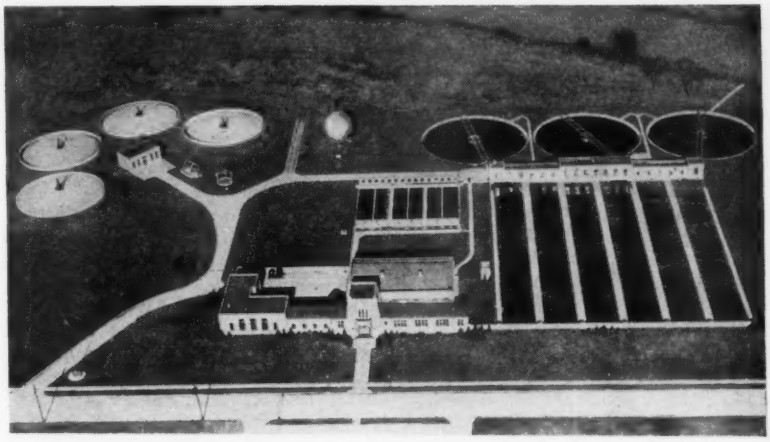
Engineering College Adopts 5-Year Plan

A five-year engineering course, to begin next September, has been adopted by Rice Institute. For the first two years, all students taking engineering will pursue uniform courses, which will include chemistry, history, and other cultural courses. In all, engineering students will be required to take at least two and a half years of English, two years of a foreign language, a year of history and one year of philosophy, psychology, sociology or additional English. An AB degree will be given to engineering students finishing four years of study; and a BS degree for the fifth year.

We are not qualified to judge whether this course is going to produce better engineers or not; but we think it is. The 5-year engineering course is a step in the right direction, and we hope that more colleges will follow suit. A better preparation and a broader viewpoint have long been needed by engineers.



Left, artist's conception of the Buggs Island dam; right, area to be flooded.



A view from the air of the Fort Wayne, Ind., activated sludge plant. The operation of this plant is described in the accompanying article by the man in charge.

RALPH A. HOOT
Superintendent

Sewage Treatment Results at Fort Wayne

A description of the plant with a summary of operating results for 1946. Overall removal of BOD 92.9% and of SS 95.1%.

THE sewage treatment plant of Fort Wayne, Ind., is of the activated sludge type. Capacity is 24 Mgd. Treatment consists of grit removal, raw sewage pumpage, primary settling, aeration, final settling, and sludge digestion. There are four digesters of the floating cover type. Sludge gas is utilized to run a Worthington engine and for plant heating. Most of the digester sludge is air dried on open, underdrained sand beds, but a part is lagooned, the sludge beds and lagoons being located about a mile from the plant. In the summer, the raw sewage is chlorinated for odor control. One chlorination station is a mile from the plant, toward the city, on the main interceptor.

Built in 1939 and 1940, the plant was officially put in operation on Jan. 1, 1941. It cost approximately $1,500,000 and was part of a $5,200,000 sewer improvement financed by a 45% WPA grant and bonds. The sewer utility income is a charge against the city water usage. For residential customers the sewage charge is 55% of the water bill. The utility is self sustaining. In 1946, total revenue was slightly in excess of $500,000, with out-of-pocket expenses $221,000; depreciation $132,000, and interest on the long term debt $88,000, leaving a net of $66,000.

Plant personnel of 28 employees consists of the superintendent, chief chemist, laboratory technician, clerk, stenographer, mechanical crew of four, electrician, two janitors, crane-bulldozer operator, sludge crew of four, one janitress and laboratory dishwasher, four control operators, four aeration operators, one grit-digester and one combination digester-relief operator. All these work days from 8 to 5, except the four control and four aeration operators who work six on and two off. This means that the plant operationally consists of a two man shift, one control operator and one aeration operator.

Sequence of Operation

The sewage comes into the plant 34 ft. below grade level and passes first into the grit chamber which, in addition to grit removal equipment, includes a 4-inch trash rack and a ¾-inch mechanically cleaned bar screen. The grit is lifted 40 ft. by V-bucket elevators, washed, dumped into a truck and used for fill. The grit chamber is provided with hydraulically operated inlet and outlet gates.

From the grit chamber the sewage flows into the wet well and from the wet well is lifted 34 ft. to plant level. It then flows successively by gravity through the primary tank, the aeration tanks and the final tank. From the final tank it is discharged into the Maumee river. Grease is skimmed at the outlet end of the primary tank. Waste activated sludge flows back to the wet well and is removed in the primary tank. Raw (primary) sludge is drawn by gravity to a raw sludge pit in the control building and pumped from there to the digesters. The grease also goes to the raw sludge pit as a part of the raw sludge.

Following sludge digestion the good "supernate" is brought back to the primary tank or wet well. Poor or heavy supernate is pumped to a 3 Mg. supernate lagoon. Surface drainage from there dribbles back into one of the interceptors. The digested sludge is pumped to open air sand beds. In winter both sludge and heavy supernate is lagooned.

The gas from the digesters is passed through gas purifiers, and used to operate the gas engine and to heat the plant. Gas is stored in the high pressure holder. Excess raw gas is discharged through a waste gas burner located on top of the digester building.

Operating Procedure

During dry weather the sewage flow is generally held to a maximum of 24 Mgd. although with "good" activated sludge the plant rate may go higher and with "poor" sludge be set lower. This means, since the average daily dry weather flow is about 18 Mgd., with a day time peak of 28 to 30 Mgd. and a night time minimum of 10 to 12, that there will be some throttling during the day time using the interceptor

as a reservoir. Free flow can prevail at night. However, in order to keep odors and moisture from the interceptor from coming into the grit chamber the plant is usually operated with the influent gates "just dipped." Periodically, when the sewage flow is right and the grit operator is on duty, complete free flow is established to clean the settled grit from the interceptor.

Raw sludge is drawn twelve times daily on the odd hours, at a rate established by the chemist. This rate depends primarily on the sludge blanket in the primary tank as determined by air bubblers as well as the quality of the sludge. Since the raw sludge is discharged by gravity over telescoping valves in a special raw sludge draw room, raw sludge quality is easily determined. Grease is skimmed twice daily, 9 a.m. and 3 p.m., and 9 a.m. only on Saturday and Sunday and holidays.

Storm Flow Operation

For storm flows the plant influent gates are of necessity throttled nearly to closing with the results that an appreciable head builds up in the interceptor. Most of the storm water is diverted direct to the river through 22 regulators on the interceptors. There is no by-pass at the sewage plant other than to by-pass secondary treatment. All sewage coming to the plant must receive primary treatment.

Although the combined capacity of the raw sewage pumps is 55 Mgd., plant aim is not to exceed a 42-Mgd. rate. This maximum has been set because above it there is a tendency for the sludge in the primary tank to be swept out. For the 42-Mgd. storm flow rate the detention in the primary tanks is 34 minutes; for the 24-Mgd. dry weather flow, the detention is 60 minutes and for the plant maximum of 55 Mgd. it would be but 26 minutes.

Secondary Treatment Operation

The aim is to maintain approximately 2,000 ppm. in the mixed liquor. Since the incoming solids (settled sewage) average 10 tons per day, waste rate has to approximate that. Activated sludge is wasted continuously with the rate set daily after the previous day's mixed liquor solids have been determined.

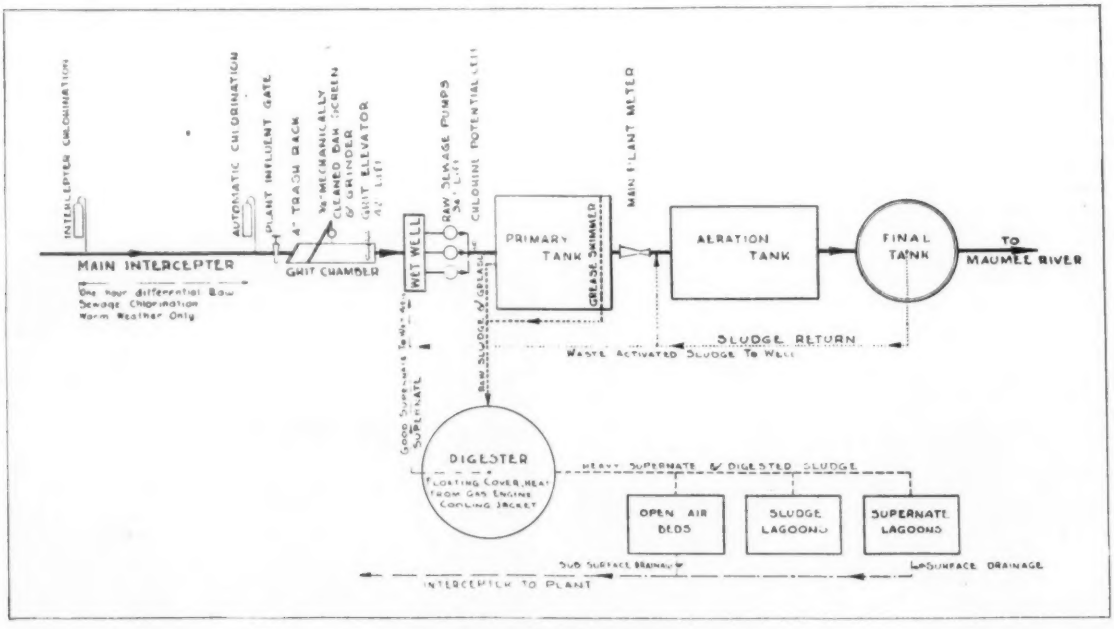
Dissolved oxygen tests are made on the settled sewage, the three mixed liquors (3 tanks) and the combined final effluent at 8 a.m. and 4 p.m. daily, Monday to Friday. The 8 a.m. test Saturday, in addition to the Saturday morning mixed liquor test, makes it possible to set the waste rate and air requirements for over the week-end. Saturday and Sunday sewage flows and air demands are light.

Settleable solids are determined each four hours by the aeration operator. Sludge blanket in the final tanks is determined every two hours by air bubblers, with the determination being hourly in case of bulking.

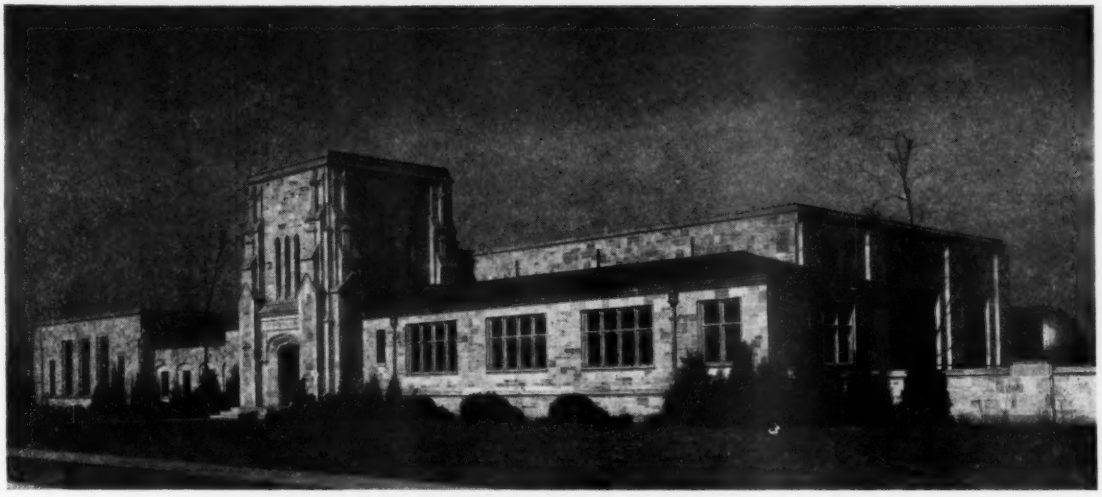
Return sludge rate averages about 25%. Normal operation is for a 1.0-Mgd. rate per tank 9 p.m. to 9 a.m. and a 1.5-Mgd rate 9 a.m. to 9 p.m. In case of bulking rates are stepped up, the maximum is 3.0 Mgd. per tank. Air is added to maintain a minimum of at least 2 ppm DO at the outlet of the areation tanks. Much higher DOs are desired and usually obtained. Sample days are Monday to Friday inclusive and alternate Saturday and Sunday. Samples are omitted the day before a holiday. All samples are stored in a refrigerator.

Every hour on the half-hour, the aeration operator makes his sampling routine, collecting samples of the raw, primary tank influent settled, final effluent, mixed liquor, and waste activated sludge. The raw and primary influent samples are prorated according to the sewage flow. The basic tests on sewage samples are pH, Settleable Solids, Suspended Solids, per cent Volatile and BOD.

Raw sludge is sampled twice per draw, seven days a week. Digested sludge is sampled as drawn; also the supernate. Sludge and supernate are tested for pH, percent solids and percent volatile. "Good" supernate brought back to the plant is also tested for BOD. River samples are collected three times weekly on the river above and six miles below. Standard tests are temperature, dissolved oxygen and BOD.



Flow sheet of the Fort Wayne plant.



The Fort Wayne plant as it looks to the passer-by.

In addition to the laboratory routine indicated under *sampling*, laboratory work includes a complete sewage analysis on the raw and final effluent each month on one day's composite. This special analysis includes: Settleable Solids, Suspended Solids, Volatile Solids, pH, 5-day BOD, Grease, Acidity, Alkalinity, Ammonia Nitrogen, Organic Nitrogen, Total Nitrogen, Nitrite, Nitrate, Total Sulfide and Chloride.

Laboratory work also includes H_2S determination on the raw and purified gas; gas engine crankcase oil acid-neut. number; chlorine demands; sewage gas analysis; and industrial waste checks; as well as the usual miscellaneous tests associated with sewage plant control.

Paul Brunner, currently vice-president Indiana Sewage Association, Northern Section, is chief chemist. Brunner's duties include in addition, supervision over the purification process such as setting air rates, establishing waste activated rates and raw sludge draws. He is second in charge in the plant.

1946 Operating Results

Raw Sewage Flow.—Total for the year 6,846,900,000 gallons, an average of 18.73 Mgd. Maximum day 36.97 Mg; minimum, 10.72. Sewage flow was 117% of city water pumpage.

River Data.—Total flow 245,475,000,000 gallons, with a daily maximum of 7.86 billion in June and a minimum of 42 million in October. The day of the river minimum, the sewage flow was 40% of the river flow. For the year, the raw sewage was 2.79% of the total river flow. The amount of sewage bypassed secondary treatment was .13% of the total river flow.

Gas Production.—Total gas produced was 66,579 Mcf; 50,033 Mcf was used by the engine; 5,463 Mcf was used for plant heating; 11,073 Mcf or 16.6% was wasted. Average gas production was 182,500 cubic feet per day.

Gas Engine Operation. Total hours the engine was operated amounted to 8,376 or 95.6% of the time. Air pumped totalled 5,063 Mcf or 94.7% of total air used. Hp. hours per gallon makeup oil amounted to 6,610.

Value of Gas Utilized.—The electric blower delivers 10 Mcf of air per day and costs $75 to operate. The saving, therefore, in electric power due to pumping 5,063 Mcf of air by using sewage gas aggregates $38,000. The saving in fuel oil for heating amounted to $1,541. Total saving resulting from gas utilization was $39,541.

Electric Blower Operation.—Electric blowers operated 1,025 hours at a cost of $2,581 and delivered 282.96 Mcf air, a cost of $9.12 per Mcf. Blowers have three capacities—7,000, 4,200 and 2,800 Cfm. Considerable of the 1946 operation was at 4,200 and 2,800 Cfm to supplement the gas engine. At full load, blower operation costs $7.50 per Mcf. At intermediate and low load unit cost increases.

Raw Sewage Pump Power.—Total Kwh used for raw sewage pumpage was 1,165,000; the cost was $17,587, Mg pumped was 6,846.96, and power cost per Mg was $2.57. With a lift of 34 feet, the cost per Mg per 1 ft. lift was 7.56¢.

Distribution of Electric Power.—The electric blowers used 170,900 Kwh, or 9.7% of the total. Raw sewage pumps used 1,165,100 Kwh, or 66.3%. Small motors and lights used 420,800 Kwh, or 24.0% of the total.

Chlorination Summary.—A total of 90,000 lbs. of chlorine was used; chlorination was started on June 24 and stopped on Sept. 16, a total of 85 days. The average usage per day was 1,060 lbs., and per Mg, 58.3 lbs. The cost of chlorination per Mg was $1.37.

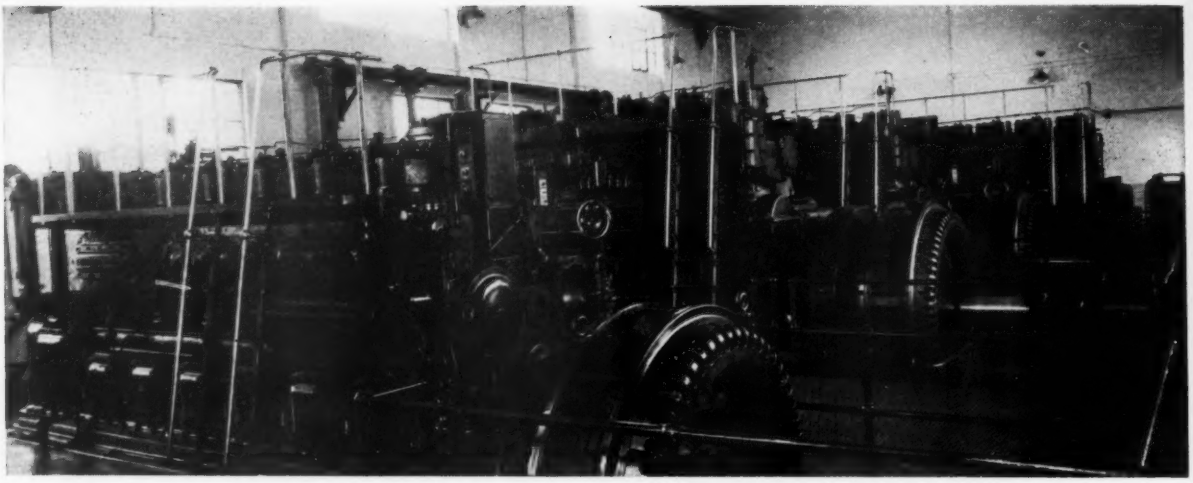
Aeration and Sludge Return.—The sewage flow totalled 6,495 billion gallons, and the air used amounted to 5,345 billion Cf, an average of 0.82 cu. ft. per gallon of sewage. Activated sludge returned amounted to 1,691 billion gallons or 26% of the sewage flow.

Mixed Liquor and Sludge Index.—Settleable solids averaged 219 (217 in Tank No. 1; 219 in Tank No. 2 and 220 in Tank No. 3); suspended solids averaged 2,288; ranging in the three tanks from 2,260 to 2,334; the sludge index averaged 96, ranging from 94 to 97. These are averages of 12 monthly averages.

Sewage Data.—Results of 307 test days showed raw sewage as follows: pH, 7.65; settleable solids, 4.33; suspended solids, 235; percent volatile, 66; BOD, 198. final effluent results were: pH, 7.44; settleable solids, 0.2; suspended solids, 11.3; percent volatile, 72; BOD, 15.7.

Treatment Results.—In primary treatment, 35.3% of the SS and 15.6% of the BOD were removed; in secondary treatment, 59.8% of the SS and 76.5% of the BOD; overall results: 95.1% removal of SS and 92.1% removal of BOD.

(Continued on page 41)



These four Fairbanks-Morse diesels at Oberlin have generated 58,564,200 kwh.

A Case Study in
DIESEL DEPRECIATION

A book depreciation vs actual depreciation study of a municipal power plant to answer the question "How long will our diesels last?"

W. H. GOTTLIEB

"HOW many years will our diesels last?" asks the prospective purchaser who is trying to determine whether there is profit in supplying his own power requirements. His second question is "What will diesels save in operating costs over other types of power?" The two questions must be considered together if a rational analysis is to be made. The operating costs—fuel, lubricating oil, labor and maintenance—are real, out-of-pocket expense, whereas a sinking fund, based on the probable life of the plant, might be termed "bookkeeping" expense.

In practice, we find diesel life estimates all the way from 10 years by a Pennsylvania manufacturer, anxious to charge off his equipment to high-profit, high-tax years, to 50 years by an REA engineer, equally anxious to hold down the book cost per kilowatt-hour. Oberlin, Ohio, for example planned to write off their diesels in about 14 years. However, conclusions are impossible as long as we confine our investigations to ledgers in the city clerk's office. It should be instructive to take an actual look at some diesels that the bookkeeper says are ready for the scrapheap.

Oberlin is a good subject for a study of this nature because the diesels there—three Fairbanks-Morse Model 33D—went into operation in July, 1934, are now in their fourteenth year of service, and the year Oberlin set for the complete depreciation of its generating equipment. The pertinent questions are: (1) What have these diesels done in the past 13 and a fraction years, their "official" lifetime? (2) Has their operation been profitable to the communal owners? (3) What is their present condition? Is their useful life really over or was the town too conservative in its estimate of diesel durability?

What Has the Plant Done?

The original plant, designed to improve Oberlin's electric service and reduce electric rates, consisted of one 600-hp., Model 33D12 Fairbanks-Morse diesels driving directly at 400 r.p.m. a 415-kw. F-M alternator with direct-connected exciter; and two 875-hp. Model 33D16 Fairbanks-Morse diesels operating at 300 r.p.m. and direct-connected to 606-kw. F-M alternators, also with direct-connected exciters. These three units carried the entire load until 1941, when electric current demand required the addition of a 1400-hp., 300 r.p.m. Fairbanks-Morse diesel with direct-driven 981-kw. F-M alternator and belted exciter.

This four-engine plant had generated 58,564,200 kw. hrs. by the end of August, 1947. The four diesels had run a total of 150,471 engine hours by that date, with the older units naturally accounting for the bulk of the running time. In all those years of operation, there was only one occasion on which engine failure caused the plant to drop its load—and that plant outage lasted only 10 minutes. Over the entire period of more than 13 years, the plant produced 11.98 kw. hrs. per gallon of fuel.

The answer, therefore, seems to be a record of good production with good efficiency; and of long service with impressive dependability.

Was the Plant Profitable?

The second question concerns the economical power production necessary to permit low electric rates. The residential rate under the old schedule was 8 cents per kw. hr. for the first 30; 6 cents per kw. hr. for the next 60; and 3 cents for each unit over 90. The current municipal rate starts at 5 cents per kw. hr. for the first 20; 4 cents for the next 30; 3.5 cents for the next 150; 3 cents for the next 800; and 2.5 for all over 1000. Cooking and heating rates drop quickly from 5 cents for the first 15; to 2.25 cents for the next 185; and 1 cent a kw. hr. for all over 200. In

addition, it has been the practice to give away one month's service as an annual bonus.

Although Oberlin consumers pay only an average of slightly over 3 cents per kw. hr., the electric department shows profits totalling well over $500,000 for the life of the plant. In the five years ending Dec. 31, 1946, this municipal department showed a net profit of $294,863.37. At the close of 1946, with the $262,900.43 power plant nearly paid for, the village has a net profit of $107,464.05. Diesel generating costs at Oberlin have been as low as 7.65 mills per kw. hr.

Has diesel operation been profitable to the communal owners? First, these owner-consumers have made important savings in the amounts they pay for electric service. Second, their electric department has a clear unencumbered profit of more than $107,000, consisting of a cash balance of $44,859; and liquid (largely U. S. Bonds) investments of $116,600; while the outstanding debt is $54,000.

What Is Plant's Physical Condition?

What is the present condition of the old engines and what can we expect from them now that the bookkeeper has given them up? At Oberlin we find that kw. hr. production per gallon of fuel for the most recent period for which figures are available was 11.93, virtually as good as the 13-year average. The production figures for the first eight months of 1947 therefore show no evidence of engine deterioration.

Frank Craig, who has been Superintendent of the plant since 1935, believes in an orderly maintenance program designed to keep his diesels at new-engine efficiency. Each unit is given a thorough check every 6000 hours of operation and careful records are kept of the condition of every piston, cylinder and bearing. Here is the rate of cylinder wear for the three original engines as revealed by the most recent inspections:

No. 1.... 0.00033" per 1,000 hrs.
No. 2.... 0.00013" per 1,000 hrs.
No. 3.... 0.00040" per 1,000 hrs.

Needless to say, no cylinder has been rebored and no replacement or reboring is anticipated for many years. Cook piston rings are now used on all the engines and there have been only two broken rings in more than 110,000 hours of operation. Main bearing replacement has been thought necessary on one engine, but no connecting rod bearing has ever been replaced. Maximum crankshaft wear at the rod bearings is 0.0005" for the life of the plant.

Equipment Used

Results such as these are achieved through choice of heavy-duty prime movers and good protective accessories. Marathon lubricating oil is circulated through each engine by a positive-action pressure system and, since the oil used to cool the pistons is channeled through oil coolers, a Schutte & Koerting for each of the first three engines and a Sims for No. 4. In addition to constant mechanical filtration, the lube oil is pumped from the engine every two months and cleaned in a Hilco activated clay oil purifier. New oil is added as required.

A closed cooling water system furthers the scheme of protection. Actually both "raw" and jacket water are treated with softening compounds, a D. W. Haering Co. chemical for the raw and a Dearborn Chemical Co. compound for the jacket. Frequent tests are made to determine the color and alkalinity of the water. Jacket water is circulated by a pair of 4-in. motor-driven Fairbanks-Morse centrifugal pumps from a hot well through the engines and the tubes of two Schutte & Koerting and one Sims heat exchangers. A second pair of F-M centrifugals puts raw water through the exchanger shells and out to a Cooling Tower Company atmospheric type tower. A fifth pump serves as a standby for both systems. For emergency use, there is a connection to the city water mains, but it has never been necessary to open the valve.

Fuel oil is unloaded from tank cars by a Roper rotary pump into three 10,000 gal. storage tanks, when it flows by gravity through Niagara meters to individual 750-gal. tanks in the plant basement. Engine-driven supply pumps pick up the fuel and put it through duplex Nugent pressure filters before it reaches the engine injection system. Each engine is equipped with a Woodward Type IC governor to regulate fuel injection.

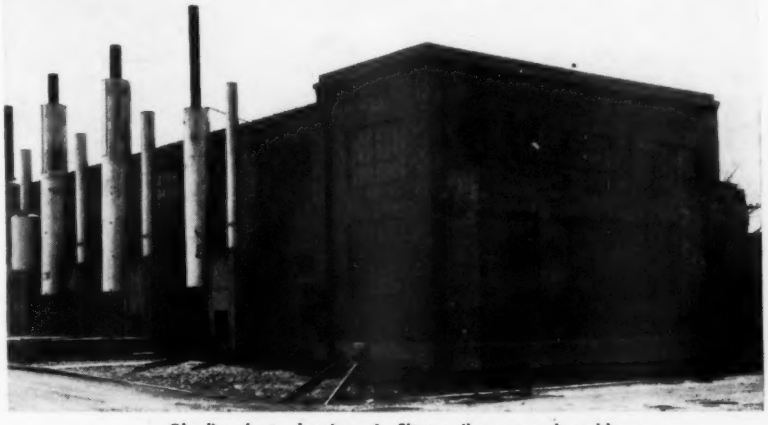
The last avenue of possible damage to the diesels is blocked by impingement-type American air filters which insure a supply of clean air for the engine scavenging air pumps. Air for No. 4 also passes through a Burgess snubber. There is another Burgess snubber for No. 4's exhaust gases; the other three engines are fitted with Maxim exhaust silencers.

A Fairbanks-Morse alarm panel carries an Alnor multi-point exhaust pyrometer and Marshalltown pressure gauges for scavenging air, lube oil, raw water, and jacket water. An alarm sounds if any pressure goes outside the predetermined limits. There is a separate similar panel for the No. 4 engine. Starting air for the diesels is supplied by either a Gardner-Denver motor-driven compressor or a gas engine-driven Fairbanks-Morse compressor.

Oberlin is primarily a college town and all municipal services are geared to the special needs and problems of Oberlin College. In recent years the school has expanded its important work in scientific research and the laboratories demand not merely an unfailing electric supply but also an unusually steady frequency. To meet this need, the plant installed a Leeds and Northrup automatic frequency control panel and as a result the electric clocks at Oberlin do not vary as much as ¼ of a second in 24 hours. The Westinghouse switchboard is specially well equipped, with Westinghouse vibrating-contact voltage regulators, switches, over-current relays, watt-hour meters, and recording kilowatt meter, an Esterline-Angus recording voltmeter, and a Leeds and Northrup recording cycle meter.

What Are the Conclusions?

What, then, are the prospects for this power plant? Are the engines ready for the junk heap? Obviously not. It is evident that the diesels are rendering service equivalent in efficiency and economy to their new engine performance. With continued operating care and maintenance of the kind they have been receiving, there is no reason to doubt that they can continue power output at undiminished efficiency for many more years. It is clear that 14 years is much too short a life expectancy for well designed and carefully operated diesels. Oberlin today is preparing to install a new 1600 HP Fairbanks-Morse opposed piston diesel. In setting up the books, town officials may well credit their new diesel with more than a 14-year life. The evidence is in their own power plant.



Oberlin plant, showing air filters, silencers and snubbers.

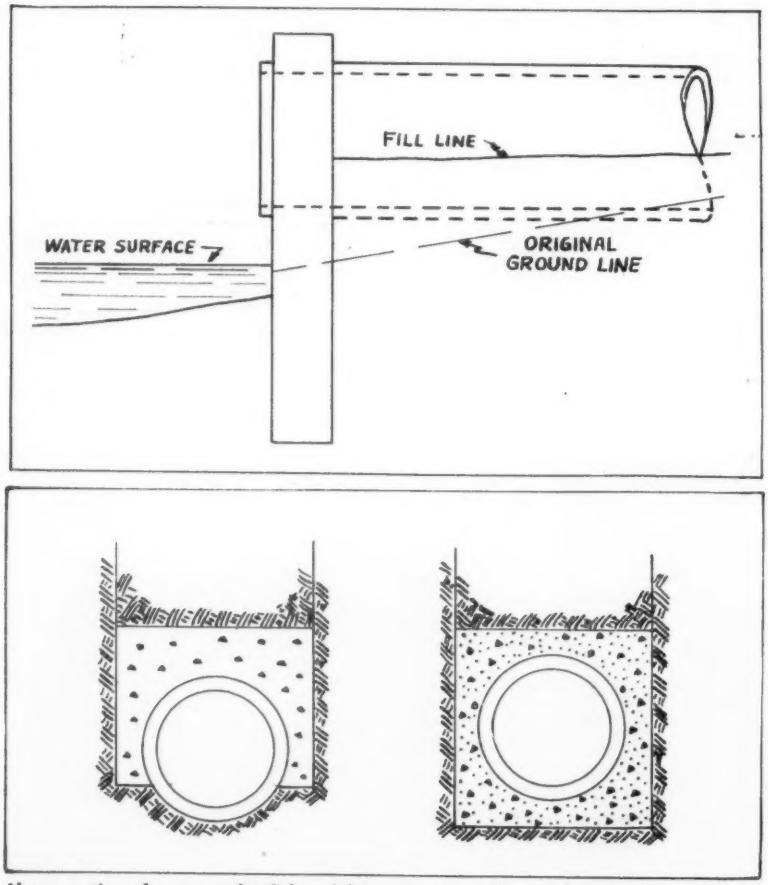
Sanitary Sewer System Designed to Lower Ground Water Level

Details of design and construction of an unusual sewer system designed to meet local conditions of high water use and high ground water table.

G. H. BRODRICK
Civil Engineer, Lander, Wyoming

IN the spring of 1946, Lander, Wyoming, was in critical need of additional sewer collection facilities. Lander has a population of approximately four thousand people, but there had been no extensive additions to the sewer collection system since 1907, at which time the population was about fifteen hundred. Therefore, about one half of the town was without sanitary sewer facilities and the original 12-inch outfall line was heavily overloaded from additional customers and high infiltration due to the old leaky joints.

The town is still without sewage treatment facilities but is planning primary treatment in the near future. Raw sewage is discharged into Dickinson Creek about one mile above its convergence with the Popo Agie River. Both old and new outfall lines are discharged at the same point to facilitate construction of the proposed disposal plant. There are no towns within fifty miles downstream that use the river for a source of water supply.



Above, section of sewer outlet. Below, left, construction with gravel to facilitate infiltration; right, concrete encasement in poor ground.

Soil and Ground Water Conditions

Lander is located in the Popo Agie river bottom on what was formerly meadow land. The top soil is about two feet thick with sand, gravel and boulders underneath for an unknown depth. The sand and gravel strata are always saturated with water, due to creeks and irrigation ditches above and through town, making it very difficult to have dry basements. Also, the high water table creates a difficult street maintenance problem particularly in the spring when the frost starts to go out of the ground.

It was decided by the Town Council, in the early spring of 1946, that a complete new collection system was needed for that part of town not already served and the writer was retained to furnish the necessary engineering.

It was suggested to the Council that the sewer be designed large enough to take in ground water thereby perhaps lowering the ground water table to the depth of the sewer. This suggestion was accepted and the system designed on that basis. Sewer sizes were determined from an estimate of 450 gal. of sewage per person served per day, and the infiltration of ground water on the basis of six inches of water drained out of the area covered by the sewer per day. Both of the above figures are high but were arrived at by measuring the flow of the original sewer; noting that the per capita use of water in Lander is about 1100 gal. per day in the summertime; and also observing the large flow of ground water through the sand and gravel strata.

Provisions in the Specifications

The specifications required that the top one-half of the bell-and-spigot joints be left open to permit infiltration of the ground water. Also the trench

was required to be hand backfilled to 1.5 feet above the sewer pipe with gravel to facilitate the inflow of ground water. Due to the ground water in all trenches, the sewer joints were made with asphalt and oakum rather than sand and cement mortar.

As can be seen by the accompanying picture of the 24-inch diameter outlet, the sewer is collecting a large quantity of ground water (estimated at 8.0 c.f.s.). The photograph was taken last spring when the system was 75% completed and very few users had been connected. The water table has been lowered to the extent that all houses within one-half block of a sewer line now have dry basements. The difficulties of maintenance of streets due to the high water table seem to have been eliminated on all streets that have new sewers.

The specifications allowed the use of either vitrified clay sewer pipe or concrete sewer pipe. At the time construction started it was impossible to obtain delivery of clay sewer pipe. It is thought that concrete sewer pipe will give satisfactory results in Lander because of the following conditions: (1) steep grades; most velocities are over four feet per second; (2) cool temperatures prevail in this vicinity; (3) the sewage will be kept diluted and cooled by the infiltration of ground water.

The new sewer also intercepts enough of the old sewer to relieve the overload on the old 12-inch outfall line. The new sewer is also designed so that additional parts of the original system can be cut in, if necessary, by the construction of one block of sewer line. Sewers within the town limits were placed at a minimum depth of 6 feet to provide adequate drainage to any basements that might be connected.

Scope of the Work

The contract, let to W. E. Barling, Inc., of Meeteetse, Wyoming, included the following principal items: 2300 lin. ft. of 24" sewer; 2300 lin. ft. of 21"; 1700 lin. ft. of 18"; 800 lin. ft. of 15"; 4000 lin. ft. of 12"; 3200 lin. ft. of 10"; 21000 lin. ft. of 8"; 79 standard manholes; and 3 drop manholes.

Northwest backhoe at work on trenching.

The original contract price totaled $115,000 and has been twice enlarged for a total of $17,000 more to construct an additional 5400 lineal feet of 8-inch sewer.

All trenching was accomplished with two Northwest shovels using a "back hoe" type rig. Due to the high water table and large boulders it was decided that trenching machines would not be satisfactory. It was necessary to dig some trenches with a side slope of approximately 1:1 to avoid caveins. Backfilling was accomplished by hand for the first 1.5 feet above the pipe and by bulldozer for the remainder. Construction was started at the outlet so the trenches could be drained through the completed sewer. The average progress per crew was about 275 linear feet per day of 8-inch sewer pipe and about 100 linear feet per day of 24-inch diameter pipe. The rate of progress for the other sizes of sewer pipe was about directly proportional to their diameters.

Discharge from new sewer—infiltration only.

Construction and Finance

The contractor elected to precast the reinforced concrete manholes in 4-foot sections and grout the sections in place. The specifications allowed either precast or poured-in-place manholes. The manhole inverts were constructed by placing double "Y"'s, pouring the concrete base up to the centerline of the pipe, and then breaking out the top one half of the "Y" within the manhole, after the concrete had set.

The construction was completed Aug. 1, 1947, requiring 11 months, but the contractor had been forced to suspend operations from Jan. 1 to May 1, 1947, due to excessive frost. On shady streets the frost was as deep as 4 feet, and could not be broken even with a large ripper and a D-8 "Cat."

The project was financed in two ways: (1) A general obligation bond issue of $70,000 was authorized by the voters of the town in the spring of 1946. The bonds were sold with an interest rate of 1.75% and will be retired by the Town of Lander at the rate of $5,000 of principal per year for fourteen years. (2) The remainder of the project was financed by forming the benefited property into sewer districts. The average assessment per lot is $56 for a 50-ft. by 150-ft. lot. About one-half of the people paid their assessments when the districts were formed resulting in selling $27,000 of improvement district bonds. The successful bidder obtained these bonds at an interest rate of 5%. The bonds will be retired by the affected property owners at the rate of $2700 per year of principal for ten years, or any time sooner at their option.

On the basis of operation to date the sewer is giving satisfactory service and the people of Lander seem to feel that the improvement is a good investment.

Subbases for Rigid Type Pavements

This is an abstract of data presented at an ARBA meeting by F. V. Reagel, Engineer of Materials, Missouri State Highway Dept., and published by the ARBA as Technical Bulletin No. 122.

SUBBASES are generally built for three purposes—to provide insulation against frost heave, to furnish additional load support, and to attempt to prevent pumping. The first purpose is provided by layers of porous material such as stone or sand and gravel, one foot or more thick. This construction is needed only in regions of deep frost, and where relatively pervious or permeable layers of subgrade overlie relatively impermeable layers, permitting the formation of ice lenses.

As to load support, while few question the need for this function of the subbase under flexible pavements, opinions are divided as to their necessity under the rigid types; and there is urgent need for information on the subject of whether a subbase is necessary in the absence of frost heaving or joint pumping, and whether the pavement thickness can be reduced by the use of such subbases. Certainly, subbases would be unnecessary if an adequate pavement were set upon a thoroughly compacted subgrade, and proper drainage were provided so that surface water is quickly eliminated, subsurface water is intercepted and the water table maintained at a safe level below the pavement. The first two are readily obtainable by present practices, but adequate subdrainage is perhaps the most important problem facing the engineer today; and it will not be solved until personnel trained in this field is provided and set to full-time functioning.

If a subbase is provided, there is a question as to what, if any, reduction in pavement thickness is warranted because of it. There are minimum slab thicknesses for particular loadings which cannot safely be reduced due to slab warping and the impracticability of providing uniform base section and support. It is highly probable that most highway designers currently give little if any weight to base support in selecting slab thickness.

Joint Pumping

There are large areas of the country where the problem of joint pumping is so serious that subbases are provided to prevent it, even though they are not normally considered necessary for any other reason. Pumping will be a potential problem whenever there are sufficient repetitions of heavy axle loads operating over slab ends free to deflect, laid over a subgrade in which clay and silt passing a 270-mesh sieve constitute over 50 to 55% of the soil, and where there is sufficient water to form a slurry or keep the pump primed. Solution of the problem lies in the control of one or more of these three factors—traffic loads, subgrade constituents, and water. The first is normally out of the engineer's hands; control of water is often difficult; and control of the material on which the pavement rests is sought as the remedy. If and when it becomes customary and practical to provide and maintain efficient drainage, this may prove the more economical solution.

Any treatment given to the subgrade to change its characteristics either by making it water repellent or by binding it into a mass capable of resisting water action, regardless of the thinness of the layer affected, may be considered a subbase, including chemical and bituminous treatments, surface membrane layers, and binding with admixtures of cement or bitumens. The Public Roads Administration is sponsoring trial installations of permeable and impermeable (relative terms) type granular layers, layers of cement-treated material, and oiling with one gallon of SC-2 road oil. Substitution of such oiling for a part of the subbase thickness is under consideration.

There are two schools of thought regarding the proper design of granular subbases for protection against pumping. One is that it should be as permeable as is compatible with stability, and should function as a drain to eliminate the water; the other, that it should form an impermeable top to the subgrade, which will not be picked up by water when the slab deflects. If the subbase is to serve as a drain it must have effective outlets. These may be provided by extending the subbase across the road to one or both ditches, or by placing longitudinal tile drains under the edges of the subbase, which is carried about 2 ft. beyond the edges of the pavement.

Possible weaknesses of this type are the danger of subgrade deformations or

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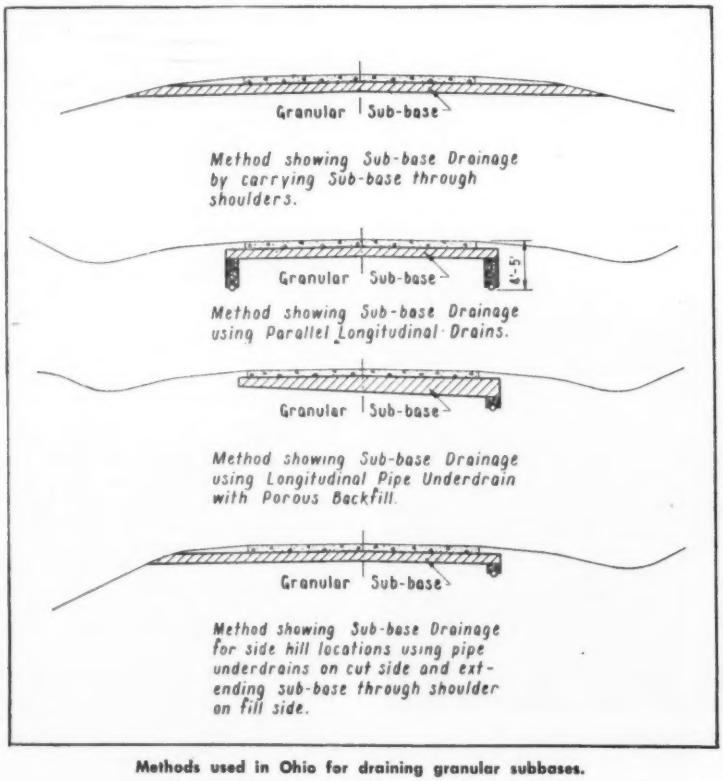

Methods used in Ohio for draining granular subbases.

Proper Handling of Joint Compound Speeds Pipe Line Construction

Faced with the necessity of quick and sound water main construction, a Texas city develops an economical jointing procedure.

R. A. TOLER
City Manager

FACED with many problems due to its sudden expansion, Giddings, Texas, found it necessary to initiate and carry on a broad program of street construction and water distribution system development. Though growth had been taking place on a relatively small, but steady scale, for many years, war and industrial developments created a sudden expansion which made it imperative for us to pave many streets; extend our water system to new areas; and enlarge other water mains which had become inadequate in capacity. Our experience has shown that cast iron mains are very desirable due to local conditions and has also indicated that steel services have a short life. Therefore it was decided to use cast iron mains with copper services on all permanent lines necessitated by this improvement program.

As time was limited and only unskilled labor available, much thought was given to the proper installation of the mains in as little time as possible. Contractors were working on road construction and would soon be in the area where the water mains were to be placed. Factors included the realization that caulking would consume quite a lot of time; it had been found that on many small mains, fire trucks, when in service, damaged the existing joints and in many cases caused leaks; also the old oakum in many joints had deteriorated.

Minneapolis-Moline model U tractor and Lull Universal loader at work in Giddings.

The City of Giddings, though cautious in trying out new ideas, had been considering rubber rings in place of oakum; but it could find no city that could pass on their experiences with rubber rings and we were therefore in doubt as to whether to chance using them. After analyzing the rings, and considering the claims made for them, we decided to try them on a small line under an unimportant street. By using the rings, it was thought that caulking time would be eliminated; and as caulking oakum is a job that depends on the employee as to quality and joint tightness, the element of chance caused by poor judgment of employees would be eliminated. We also assumed that if the rubber rings were placed properly they would eliminate leaks caused by fire trucks pumping on small mains. Having had no experience with rubber rings, the work procedure of installing them had to be analyzed as the job progressed in order to arrive at a definite decision as to whether to continue their use.

A Barber-Greene ditcher of the type used; this picture was taken near San Antonio.

Starting the Work

Ditching was started and pipe was handled by borrowing the winch truck of the Electric Department. It was found that a section of pipe could be lowered in place, and, by keeping a slight strain on the pipe, the rubber rings could be centered and placed very rapidly. It was found that at times it was difficult to center the rings perfectly if this strain were not maintained. It was found also that once the rings were centered and driven in place the strain could be removed and the next pipe hoisted in place. This eliminated the necessity of pouring each joint as it progressed and made it possible to lay pipe rapidly. The lead was

poured by a man following the pipe laying crew.

The use of rubber rings was found to require much more lead than when using oakum, but as this job was going to be under pavement the additional cost was deemed worthwhile, provided tight joints could be assured. Fairly uniform spacing of lead was secured due to the uniformity of the rubber rings.

Results on the Test Line

After constructing the test line it was found that only one leak had developed—a joint that was poorly caulked and soon repaired. No bad results were noticed when the line was pumped heavily by fire trucks. It was assumed that harboring of bacteria in the joints would be less likely. On the basis of this experience, it was decided to use rubber rings also on the main lines remaining to be built.

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Subbases for Rigid Pavements

(Continued from page 28)

irregularities which may retain water and cause loss of stability, and the possible infiltration of plastic subgrade soil into the relatively open mass, decreasing stability and blocking drainage. The former can be minimized by careful grading; the latter by placing a light layer of fine granular material below the subbase.

The impermeable type of subbase may be rolled stone containing an excess of fines, or clay-bound gravel. Since it is not intended to serve as a drain it is not always designed to cover the full width of the road section but often is carried only from one to three feet beyond the pavement edge so as to provide some lateral support. This type has the potential weakness of lack of lateral support due to limited width; it may vary greatly in supporting power if the mix is not uniform, and the edges are exposed to water softening unless the shoulders are so treated as to prevent water penetration. Portland cement stabilized soil subbases may be economical where granular material is scarce or expensive, or where the subgrade soil is suitable for such treatment, as they are permanently bonded and resistant to water softening.

Whichever type of subbase is employed, uniformity of the support to the pavement is most important. A uniformly low support may be preferable to a very high supporting value which is lacking in uniformity.

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4. If deep longitudinal drainage is necessary to reduce the water table in relatively permeable soils, care should be exercised to insure a porous granular material which will drain the subbase in a matter of hours rather than days.

5. Drainage of the subbase is a misleading consideration if the materials are such that they take several days to drain. This applies particularly to humid climates such as in Ohio.

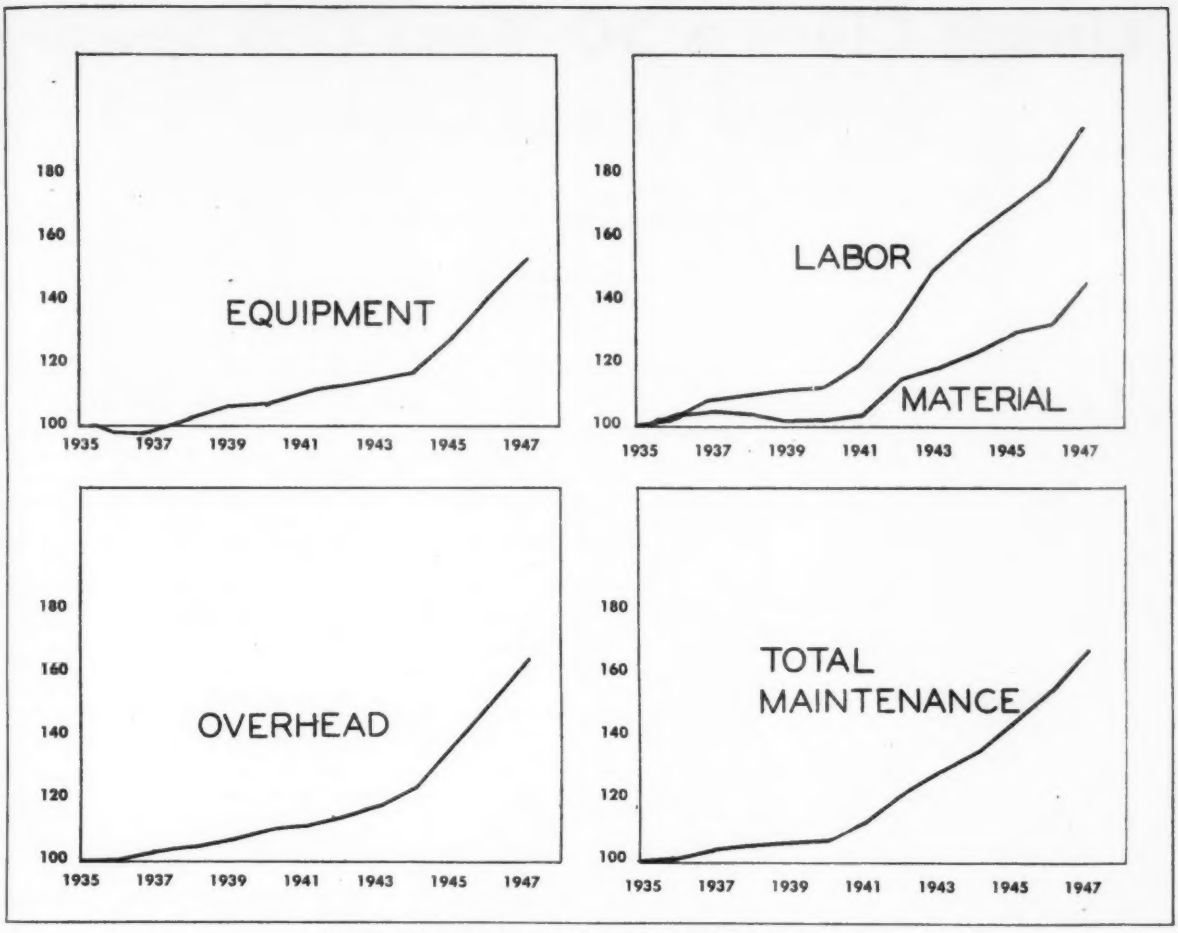
6. Continuation of the subbase through the berms for the purpose of drainage should not be used except under very special conditions. The quantity of water which a material of given cross section will drain varies inversely as the square of the distance through which it moves (according to some published information): The efficiency of drainage obtained by continuing the subbase through the berms is greatly reduced because of the low hydraulic gradient compared to that obtained by placing drains close to pavement edges. In addition, maintenance operations and normal surface erosion seal the face of the blanket course at the slope sufficiently to defeat the idea of providing a drainage medium.

7. Dense graded soil aggregate mixtures such as Ohio's T-11 can be used more economically on heavy clay soils, providing the percentage of soil fines near the surface of the subbase is kept at a low percentage.

8. The thickness of subbase required for the various types of soils may be decreased further if greater attention is paid to obtaining maximum stability of the subgrade through closer control of its moisture and density.

9. In some cases closer control of the density of the subbase may avoid pumping tendencies in the subbase under rigid payements.

10. The control of the grading and type of material for the subbase must be balanced against the cost of securing that material. To insure reasonable prices for subbases, acceptable pits should be determined before letting a project.



How the various items entering into maintenance have risen in 12 years.

How Much Have Highway Maintenance Costs Risen?

THE Committee on maintenance costs of the Highway Research Board decided in 1946 to initiate a comprehensive study to determine how much such costs have risen. The basis of this study was the actual cost of maintaining a composite 10,000-mile highway system. This system was made up of the different surface types in the same mileage proportions as they exist on the state highways of the nation. Five classes were included: non-surfaced; soil, stone or gravel surfaced; low-type bituminous; high-type bituminous; and cement-concrete.

The committee making the study consisted of J. S. Bright, chairman, deputy commissioner, Public Roads Administration; W. H. Behrens, county engineer, Linn Co., Iowa; T. H. Dennis, state maintenance engineer of California; A. Diefendorf, head of the Civil Engineering Department, University of Utah; J. J. Forrer, state maintenance engineer of Virginia; and W. K. Meyers, chief maintenance engineer of Pennsylvania.

The costs of maintenance were broken down by the committee into six items: Surface; shoulders and approaches, roadsides and drainage; traffic service; snow, ice and sand control; and bridge maintenance. Each operation in maintenance was broken down into one or more of 34 items, such as labor, material, equipment, overhead, etc. The amount (hours, gallons, miles, or other unit) of each of these 34 items necessary to perform each maintenance operation on each type of highway was determined from data furnished by state highway departments, either in their annual reports or direct to the Public Roads Administration. The latter (M-1 reports) show the unit cost of each item on 1,123 sections covering 17,400 miles of state highways.

Labor Costs

The cost of maintenance labor increased gradually from 1935 to 1940 and then sharply to its present height. The 1947 cost is 98% above the base year of 1935 and 77% above the 1940 cost. The rise in the wage rate of operators and common laborers is the highest, 104% and 103%, respectively, over 1935; the rise in the foremen's rate is the lowest, 70% over 1935. Since the

(Continued on page 33)

Lining Gives a 50-Year-Old Sewer A New Lease On Life

Previous experience in relining a sanitary sewer leads to use of asbestos-bonded paved invert pipe

WILLIAM CHADWICK
City Engineer, Racine, Wis.

TEN years ago this city was confronted with the problem of replacing a 78-inch rigid outfall sewer at Washington Park in West Racine. The method chosen at that time, on an economy basis, was to reline the old structure with 600 feet of 72-inch Armco Asbestos-Bonded paved pipe.*

So effective and satisfactory was that method of salvaging the old sewer that it was recently chosen for a second similar job. In the near-downtown industrial district of this city of 75,000 population on the shore of Lake Michigan, 26 miles south of Milwaukee, a two-ring brick sewer 66 inches in diameter flowed north into the Root River.

This combined sanitary and storm sewer has only a few feet of cover and it lies almost directly under the tail or storage tracks of the Chicago & North Western Railroad. In recent years longitudinal cracks were opening up in the outfall section of this 50-year-old sewer with the result that repair or replacement was considered advisable before a change in the cross-section became too great.

By taking early action in the summer of 1947 it was possible to plan on using a 60-inch corrugated metal pipe inside the old 66-inch diameter structure. For the reasons already mentioned, Armco asbestos-bonded paved invert pipe was selected.

*Rehabilitation of Old Brick Sewer, The Hy. Mag., May 1939.

Method of Doing the Work

First a pit 20 feet long was opened over the old sewer at the upper end of the replacement section. Most of the operations were carried on from this point except that a manhole adjacent to the south bank of the river gave access to the lower end of the line. Vent holes were cut through the roof of the old sewer at intervals of 50 to 75 feet to speed up the grouting work and to provide a place for operating a hand winch.

A novel method of handling the 12-foot lengths of 60-inch Armco pipe, each of which weighed about 1500 pounds, involved a special dolly or carriage. This rig consisted of a 4-inch pipe ridge pole supported at each end by a three-wheel dolly which rode on the bottom and sides of the old sewer and which could be raised or lowered by means of jacks to make the reliner pipe clear at the sides or top. This rig, originally designed and built by the Bark River Culvert & Equipment Company of Eau Claire, Wis., for use in relining an elliptical sewer in La Crosse, was loaned to the contractor on this job. It served its purpose very well.

Jointing of the reliner pipe had to be done from the inside because of the limited clearance between the old and new structures. For this purpose, a two-piece 24-inch coupling band was shop-riveted onto the top and bottom of adjacent sections. It lapped two corrugations over each end of the pipe, leaving a 12-inch clear space for angle irons and bolts at the sides of the pipe.

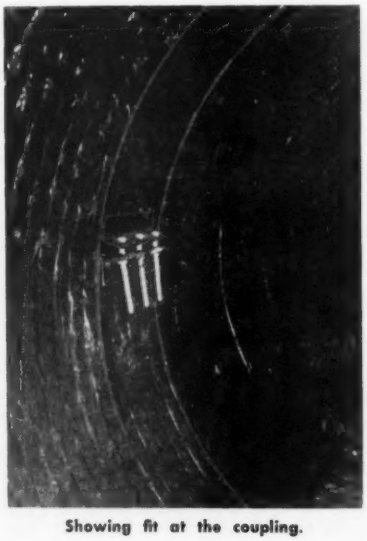
To facilitate making the connection, the half band on the previous section of pipe was spread apart by means of a trench jack. This enabled the next section, after being lowered from the dolly, to be pushed into place allowing the proper lap. Then the jack was released, and the connection bolted at the sides. Careful work in drawing the bands tight resulted in obtaining a good fit and giving watertight joints.

A hand winch operating at the surface through the vent holes previously mentioned was used to pull the dolly rig and pipe from the pit to the place where the pipe was needed.

Filling the Space Between Old and New Pipes

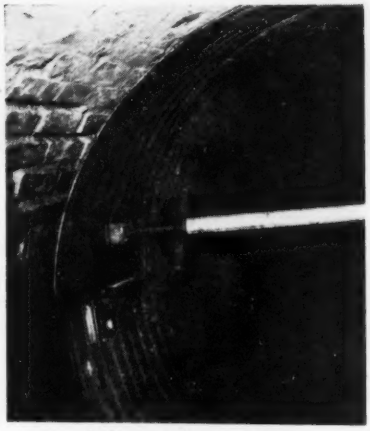
Space between the old and new structures was filled to prevent any sudden break in the old sewer from applying a concentrated pressure on the new. For this purpose a pressure grouting machine was operated from the surface. To enable this work to proceed close to the relining operations but to prevent

Tail end of puller and jack.



Showing fit at the coupling.

Pumping in the concrete.



Jack spreading coupling.

the grout (1 part cement to 6 parts sand) from flowing out at the heading, a "collar" was built at each vent hole, using heavy paper as a form. After this collar had set sufficiently, a hole was broke grouti preced the u transit on the

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Highway Maintena

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cost of labor amounts to approximately half of the total maintenance expenditure, the rise in these costs accounts for the greater part of the increase in the maintenance of expenditure.

Material Costs

The 1947 cost of maintenance materials is 46% above the 1935 rate and 45% above the 1940. These prices increased slightly in 1936-1937 and then decreased until 1940; thereafter they increased in similar proportion to the labor costs. Some material items, such as lumber, have more than doubled in cost over 1935. The large increase in the cost of these items can be attributed in part to the present scarcity. The prices of other items, such as bituminous mix, have risen only slightly. The slow rise in the cost of these items is probably due to increased competition, improved methods, improved equipment, etc.

Equipment Costs

Equipment rental rates decreased slightly in 1937 and then increased slowly until 1944, after which they showed a sharp rise. The 1947 rates are 53% above the 1935 rates and 43% above the 1940 rates. This moderate rise is due chiefly to the lag in equipment purchases by the states. Most of the states base their depreciation rates, through the application of some formula, on the purchase price of the equipment. This means that the depreciation realized on each piece of equipment repays the purchase price of the equipment but does not provide a large enough reserve to replace the equipment at an increased price level. Therefore, this portion of the equipment cost has not as yet been affected fully by the ri Howe the eq by th for m

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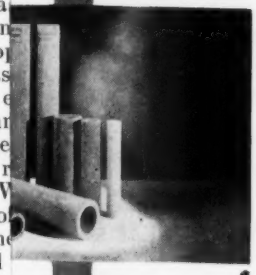
PUBLIC WORKS *Engineering Data*

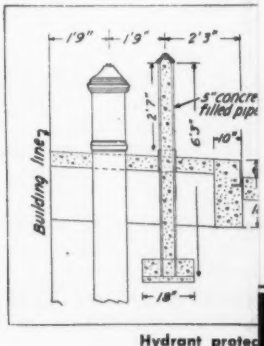
Protecting Hydra Dar

The problem of prote age by traffic receives Borough of Manhattan, number of hydrants bro These breakages are ca truckmen, but also by s covered curbs. Placemer buildings often interfer space under so many c valuable in congested ar a store show window or ing is undesirable.

The accompanying ill to the problem that ha for locations where lon have been authorized o forms. Placing hydrants ways has been found e areas adjacent to colum ways or overhead bridge The sketch herewith is r of the Department of W tricity of the Borough o



The fenders are 5-in filled with concrete and to a depth of 3'8" below inch curb surrounding th is a standard borough st the curb is 2'3". Minim from the building line is



Hydrant protec

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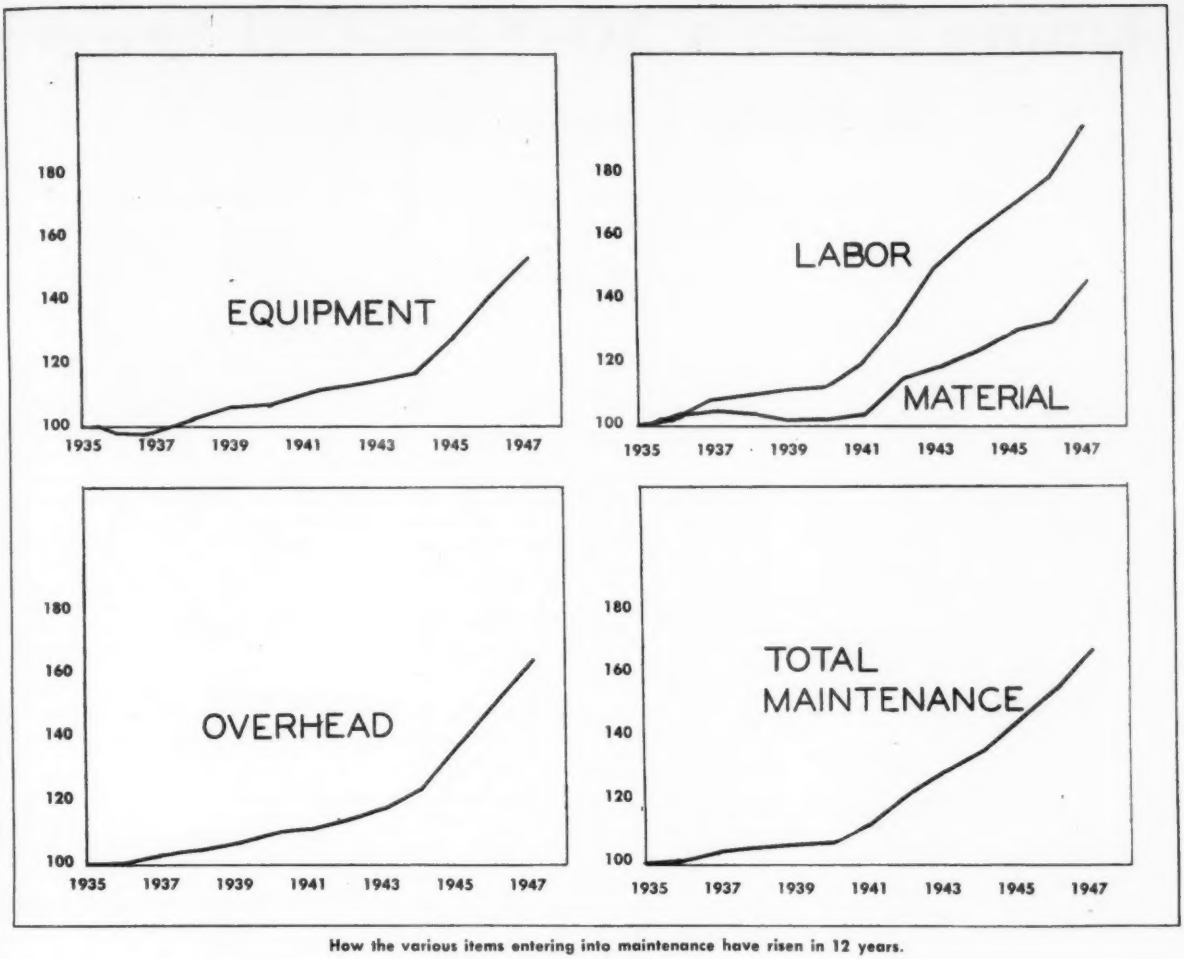
8. The thickness of subbase required for the various types of soils may be decreased further if greater attention is paid to obtaining maximum stability of the subgrade through closer control of its moisture and density.

9. In some cases closer control of the density of the subbase may avoid pumping tendencies in the subbase under rigid payements.

10. The control of the grading and type of material for the subbase must be balanced against the cost of securing that material. To insure reasonable prices for subbases, acceptable pits should be determined before letting a project.



How the various items entering into maintenance have risen in 12 years.

How Much Have Highway Maintenance Costs Risen?

THE Committee on maintenance costs of the Highway Research Board decided in 1946 to initiate a comprehensive study to determine how much such costs have risen. The basis of this study was the actual cost of maintaining a composite 10,000-mile highway system. This system was made up of the different surface types in the same mileage proportions as they exist on the state highways of the nation. Five classes were included: non-surfaced; soil, stone or gravel surfaced; low-type bituminous; high-type bituminous; and cement-concrete.

The committee making the study consisted of J. S. Bright, chairman, deputy commissioner, Public Roads Administration; W. H. Behrens, county engineer, Linn Co., Iowa; T. H. Dennis, state maintenance engineer of California; A. Diefendorf, head of the Civil Engineering Department, University of Utah; J. J. Forrer, state maintenance engineer of Virginia; and W. K. Meyers, chief maintenance engineer of Pennsylvania.

The costs of maintenance were broken down by the committee into six items: Surface; shoulders and approaches, roadsides and drainage; traffic service; snow, ice and sand control; and bridge maintenance. Each operation in maintenance was broken down into one or more of 34 items, such as labor, material, equipment, overhead, etc. The amount (hours, gallons, miles, or other unit) of each of these 34 items necessary to perform each maintenance operation on each type of highway was determined from data furnished by state highway departments, either in their annual repofts or direct to the Public Roads Administration. The latter (M-1 reports) show the unit cost of each item on 1,123 sections covering 17,400 miles of state highways.

Labor Costs

The cost of maintenance labor increased gradually from 1935 to 1940 and then sharply to its present height. The 1947 cost is 98% above the base year of 1935 and 77% above the 1940 cost. The rise in the wage rate of operators and common laborers is the highest, 104% and 103%, respectively, over 1935; the rise in the foremen's rate is the lowest, 70% over 1935. Since the

(Continued on page 33)

Lining Gives a 50-Year-Old Sewer A New Lease On Life

Previous experience in relining a sanitary sewer leads to use of asbestos-bonded paved invert pipe

WILLIAM CHADWICK
City Engineer, Racine, Wis.

TEN years ago this city was confronted with the problem of replacing a 78-inch rigid outfall sewer at Washington Park in West Racine. The method chosen at that time, on an economy basis, was to reline the old structure with 600 feet of 72-inch Armco Asbestos-Bonded paved pipe.*

So effective and satisfactory was that method of salvaging the old sewer that it was recently chosen for a second similar job. In the near-downtown industrial district of this city of 75,000 population on the shore of Lake Michigan, 26 miles south of Milwaukee, a two-ring brick sewer 66 inches in diameter flowed north into the Root River.

This combined sanitary and storm sewer has only a few feet of cover and it lies almost directly under the tail or storage tracks of the Chicago & North Western Railroad. In recent years longitudinal cracks were opening up in the outfall section of this 50-year-old sewer with the result that repair or replacement was considered advisable before a change in the cross-section became too great.

By taking early action in the summer of 1947 it was possible to plan on using a 60-inch corrugated metal pipe inside the old 66-inch diameter structure. For the reasons already mentioned, Armco asbestos-bonded paved invert pipe was selected.

*Rehabilitation of Old Brick Sewer, The Hy. Mag., May 1939.

Method of Doing the Work

First a pit 20 feet long was opened over the old sewer at the upper end of the replacement section. Most of the operations were carried on from this point except that a manhole adjacent to the south bank of the river gave access to the lower end of the line. Vent holes were cut through the roof of the old sewer at intervals of 50 to 75 feet to speed up the grouting work and to provide a place for operating a hand winch.

A novel method of handling the 12-foot lengths of 60-inch Armco pipe, each of which weighed about 1500 pounds, involved a special dolly or carriage. This rig consisted of a 4-inch pipe ridge pole supported at each end by a three-wheel dolly which rode on the bottom and sides of the old sewer and which could be raised or lowered by means of jacks to make the reliner pipe clear at the sides or top. This rig, originally designed and built by the Bark River Culvert & Equipment Company of Eau Claire, Wis., for use in relining an elliptical sewer in La Crosse, was loaned to the contractor on this job. It served its purpose very well.

Jointing of the reliner pipe had to be done from the inside because of the limited clearance between the old and new structures. For this purpose, a two-piece 24-inch coupling band was shop-riveted onto the top and bottom of adjacent sections. It lapped two corrugations over each end of the pipe, leaving a 12-inch clear space for angle irons and bolts at the sides of the pipe.

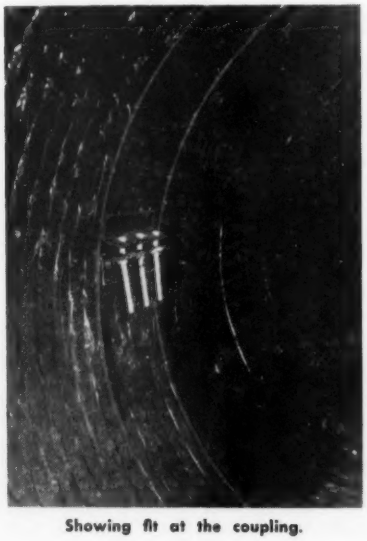
To facilitate making the connection, the half band on the previous section of pipe was spread apart by means of a trench jack. This enabled the next section, after being lowered from the dolly, to be pushed into place allowing the proper lap. Then the jack was released, and the connection bolted at the sides. Careful work in drawing the bands tight resulted in obtaining a good fit and giving watertight joints.

A hand winch operating at the surface through the vent holes previously mentioned was used to pull the dolly rig and pipe from the pit to the place where the pipe was needed.

Filling the Space Between Old and New Pipes

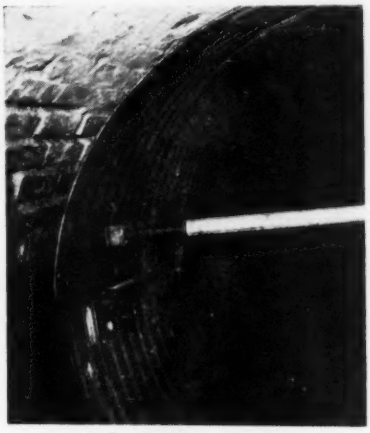
Space between the old and new structures was filled to prevent any sudden break in the old sewer from applying a concentrated pressure on the new. For this purpose a pressure grouting machine was operated from the surface. To enable this work to proceed close to the relining operations but to prevent

Tail end of puller and jack.



Showing fit at the coupling.

Pumping in the concrete.



Jack spreading coupling.

the grout (1 part cement to 6 parts sand) from flowing out at the heading, a "collar" was built at each vent hole, using heavy paper as a form. After this collar had set sufficiently, a hole was broken through at the top to enable grouting to be completed back to the preceding collar. This method enabled the use of considerable amounts of transit mix concrete which cut down on the time and cost of grouting.

Because of the gap in the bituminous pavement at each side of the joint in the pipe, hot asphalt was applied to complete the pavement and to completely seal each joint. The flow of sewage was uninterrupted during the construction period but no storm water of any consequence entered the sewer before the job was completed in late September.

Contractors on the job were the R-W Co. (Louis Radin and Bernard Walter) of Milwaukee, who performed the job at a bid price of $15,480 including the corrugated pipe. George Seidenglanz was superintendent on the job. The design and supervision of the work was under the direction of the city engineer's office. Henry A. Nelson is the commissioner of public works.

Highway Maintenance Costs

(Continued from page 31)

cost of labor amounts to approximately half of the total maintenance expenditure, the rise in these costs accounts for the greater part of the increase in the maintenance of expenditure.

Material Costs

The 1947 cost of maintenance materials is 46% above the 1935 rate and 45% above the 1940. These prices increased slightly in 1936-1937 and then decreased until 1940; thereafter they increased in similar proportion to the labor costs. Some material items, such as lumber, have more than doubled in cost over 1935. The large increase in the cost of these items can be attributed in part to the present scarcity. The prices of other items, such as bituminous mix, have risen only slightly. The slow rise in the cost of these items is probably due to increased competition, improved methods, improved equipment, etc.

Equipment Costs

Equipment rental rates decreased slightly in 1937 and then increased slowly until 1944, after which they showed a sharp rise. The 1947 rates are 53% above the 1935 rates and 43% above the 1940 rates. This moderate rise is due chiefly to the lag in equipment purchases by the states. Most of the states base their depreciation rates, through the application of some formula, on the purchase price of the equipment. This means that the depreciation realized on each piece of equipment repays the purchase price of the equipment but does not provide a large enough reserve to replace the equipment at an increased price level. Therefore, this portion of the equipment cost has not as yet been affected fully by the rising prices of new equipment. However, other factors entering into the equipment cost have been affected by the rising price levels, accounting for much of the increase shown.

It would be well for states, counties and cities to study the depreciation returns on their old equipment and, if these returns are not large enough to replace the particular item of equipment, to raise the depreciation charges sufficiently to cover these increased replacement costs.

Overhead Costs

Overhead costs have risen less than labor costs—62% above the 1935 base and 47% above 1940. The overhead costs are made up of four parts: engineering salaries; skilled clerical and supervisory salaries; salaries of clerks and typists of the lower grades and unskilled laborers; and the transportation costs of the engineers and supervisory personnel. Other portions of the overhead costs, such as rent, heat, light, etc., represent such a small percentage of the total costs that they were not included. The rise in overhead costs can be largely attributed to the rise in the lower salaries. These have risen almost as much as the labor items.

Total Maintenance Costs

The trend of total maintenance costs follows much the same general pattern as the labor cost trend. It rises slightly from 1935 to 1940 and then sharply to its 1947 height, 71% above 1935 and 58% above 1940. The 8% rise from 1935 to 1940 is due principally to the rise in maintenance labor rates. This rise manifests itself directly in the labor trend curve and indirectly in the overhead and equipment trend curves. Both of these latter costs are made up, to a large extent, of labor which is paid directly from state funds.

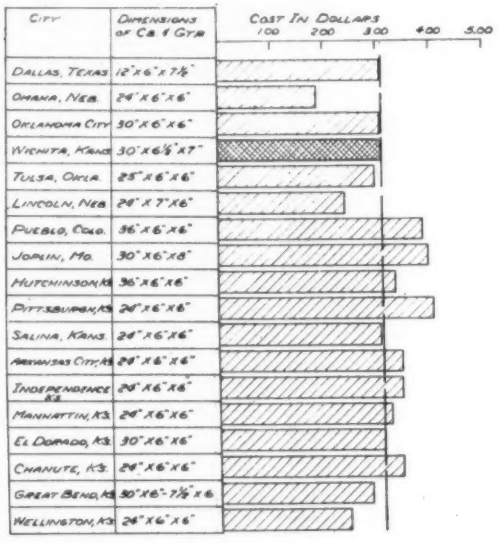
The average maintenance expenditure on the nation's state highway system during the years 1934, 1935 and 1936 was $403.77 per mile. The cost per mile of maintaining the representative 10,000 miles for the year 1935 was $402.82. The cost per mile of these same fixed unit maintenance items was $435.56 in 1940 and $689.96 in 1947.

It is believed that the cost of maintaining this representative mile, including as it does all the cost factors entering into the maintenance and operation of a typical mile of state highway system, indicates the expenditures per mile necessary to maintain and operate representative highways at the present price level. There will be some minor variations, due to differences in wage scales, highway surface types, etc., in any particular state, but these variations should not affect the total 12-year rise by more than 10%. Large increases in the weight or volume of traffic in specific areas would also increase the required maintenance expenditures in those areas over and above the amount previously indicated in the report. It is believed that each state should, using its own costs and conditions, investigate the unit cost rise in its area and compare that rise with the increase in its maintenance expenditures over the same period of years.

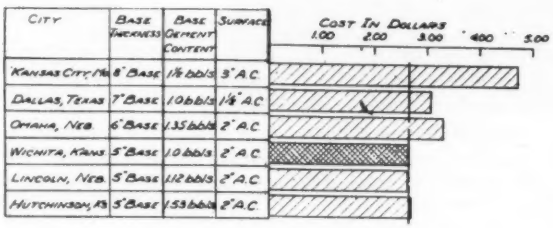
The Jeffrey Research Center. **See page 62.**

PAVING AND SEWER

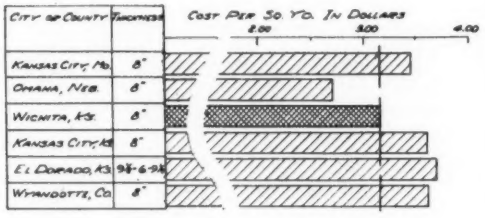
COMBINED CURB & GUTTER



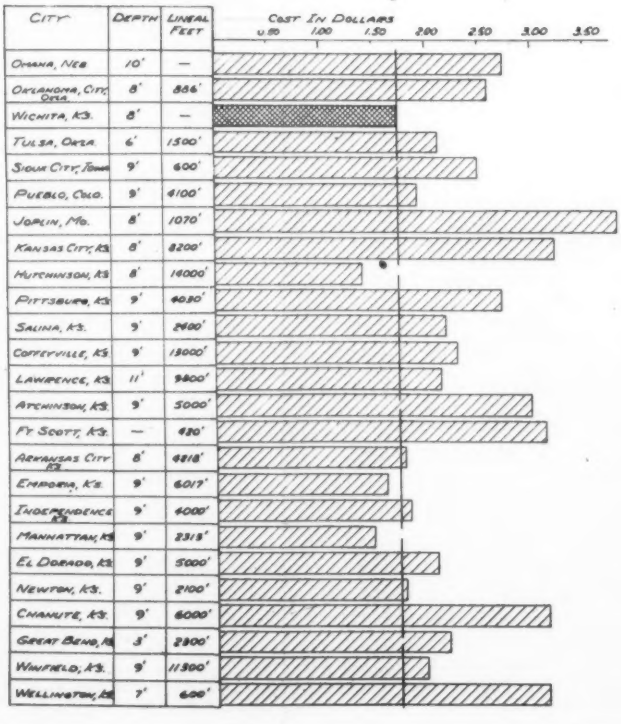
ASPHALTIC CONCRETE PAVING

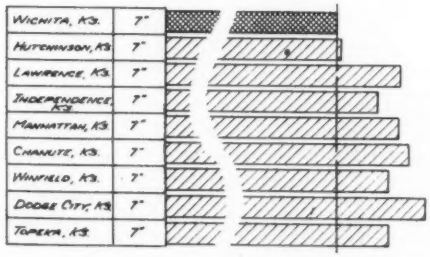


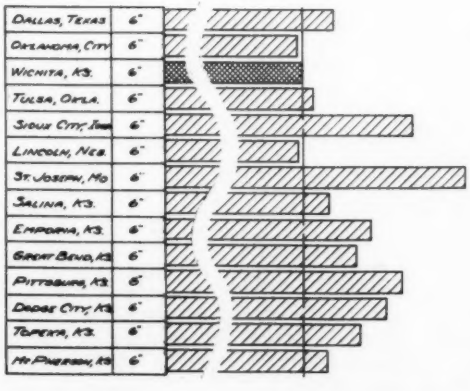
CONCRETE PAVEMENT



8" SANITARY SEWER







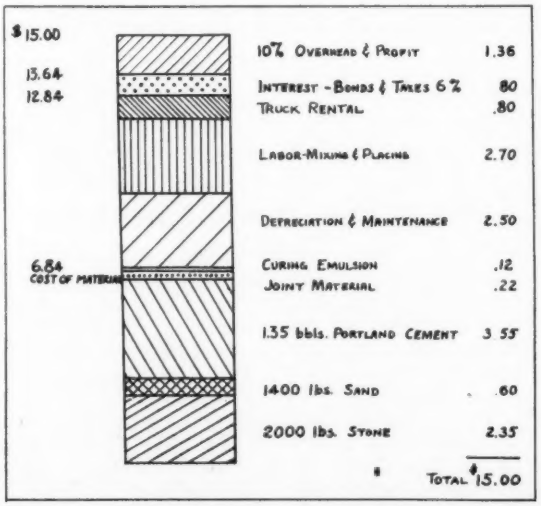
VER COSTS

THE engineering division of Wichita, Kansas, under the direction of Eugene N. Smith, Director of Service, has recently conducted a survey to determine paving and sewer construction costs throughout the Midwest. The results of this analysis are presented in graphical form in the accompanying charts. In almost every case costs are based on work performed during 1947, with the remaining few dating from the latter part of 1946.

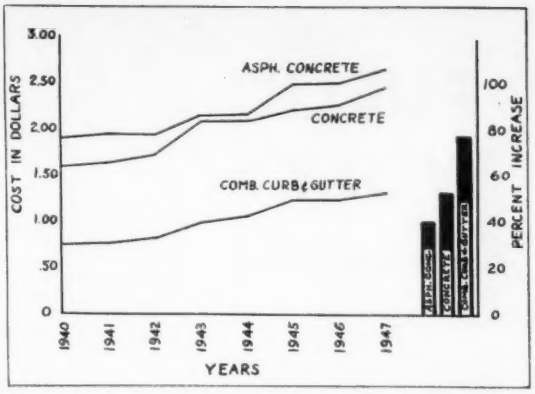
Data for the analysis were obtained from questionnaires sent to 23 cities in Kansas having a population over 5,000 and to 13 other cities with populations varying from 37,000 to 400,000 located in Missouri, Nebraska, Oklahoma, Arkansas, Iowa, Colorado and South Dakota. Replies were received from 85% of the Kansas cities and from 77% of the out-of-state cities. A few cities could not return complete reports because no recent contracts had been performed in the categories of construction mentioned in the questionnaire.

It is difficult to make a comparative analysis of costs on these types of construction because there are so many variable factors. For example, sewer costs would be greatly affected by unusual obstructions. On all sewer jobs reported, however, obstructions encountered were noted as "average," "slight" or "none."

When answering the question of curb and gutter costs many replies gave data on curb and gutter construction incidental to the complete paving of a street. The information desired was the cost of construction of combined curb and gutter alone. In an effort to give an honest analysis of these costs the bar graph was set up to include an average amount of excavation together with the curb and gutter costs, all on a lineal foot basis.



Cost analysis of concrete pavement, Wichita, Kansas, 1947. Cost of one sq. yd. of 6" concrete pavement, $15.00 ÷ 6 = $2.50.



Graph showing increase of paving costs in Wichita, Kansas, for period 1940 to 1947.

This was deemed feasible since combined curb and gutter is generally constructed in well established secondary residential streets which require only a small amount of excavation or grading and which are usually held to a maximum width of 28 to 30 feet.

In 1947 Wichita's paving costs were 40% to 76% above the 1940 level. However, the officials of Wichita feel that this study shows conclusively that paving and sewer construction costs in their city continue to be low in comparison with prevailing costs in the Midwest area.

Average Item Bid Prices on Federal Aid Highways

Bid prices on various items of highway construction have been issued by the Public Roads Administration. These are for secondary highways and cover only the third quarter of 1947.

Borrow.—Average borrow bids were 75¢ per cu. yd., ranging from 41¢ in Washington ang 43¢ in Mississippi and Tennessee to $1.51 in Wyoming and Colorado.

Excavation.—Common excavation bids averaged 32¢ per yd.; unclassified averaged 45¢; solid rock excavation averaged $1.28; common, dry, structural, $3.33 and unclassified structural $3.22, Variation on these items are normal.

Steel.—Pavement reinforcement averaged 6.2¢; structural reinforcement, 9.2¢; and structural steel 12.5¢.

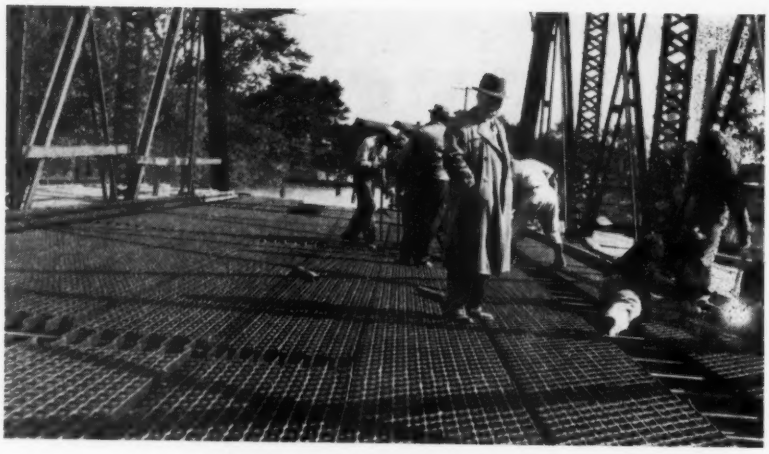
Bases.—Gravel and clay-gravel bases averaged 32¢ per sq. yd.; macadam and stone, 93¢; and portland cement concrete $3.78.

Surfaces.—Average bid prices for surfaces were, per sy. yd.: Clay and clay-gravel, 15¢, but much higher in some areas; bituminous surface treatment 24¢ and moderately uniform; bituminous road mix, 38¢; bituminous intermediate, 58¢; bituminous concrete, 95¢; and portland cement concrete, $3.19.

Pipe. It is not stated if the following prices include laying, but it is believed they do: Cast iron, 18-in., $6.00 on only 129 ft.; 6-in. clay, $1.41; 24-in. re. con., $4.32; 24-in. gal. iron, $3.91.

Structural Concrete—Superstructures, $46.25 per cu. yd.; substructures, $46.25; and foundations and footings, $38.84.

PUBLIC WORKS *Engineering Data*



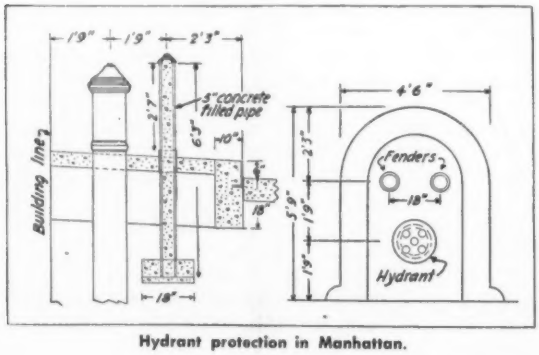
Working on Rome's Bloomfield bridge.

Protecting Hydrants Against Traffic Damage

The problem of protecting hydrants from damage by traffic receives much attention in the Borough of Manhattan, New York City, where the number of hydrants broken each year exceeds 200. These breakages are caused not only by careless truckmen, but also by snow plows jumping snow-covered curbs. Placement of hydrants adjacent to buildings often interferes with use of the vault space under so many of the sidewalks, which is valuable in congested areas. A location in front of a store show window or close to a residential building is undesirable.

The accompanying illustration shows a solution to the problem that has been used in New York for locations where long stretches of drop curb have been authorized opposite truck loading platforms. Placing hydrants in safety islands in roadways has been found effective; also, in the safe areas adjacent to column supports for express highways or overhead bridges, where conditions permit. The sketch herewith is reproduced by the courtesy of the Department of Water Supply, Gas & Electricity of the Borough of Manhattan.

The fenders are 5-inch extra strong steel pipe filled with concrete and set firmly into the ground, to a depth of 3'8" below the sidewalk level. The 10-inch curb surrounding the fenders and the hydrant is a standard borough steel curb design. Radius of the curb is 2'3". Minimum spacing of the hydrant from the building line is 1'9" for high pressure service and 1'6" for low pressure. The sidewalk shown around the hydrant is 5" thick. A sleeve is placed around each fender where it passes through the sidewalk.



Hydrant protection in Manhattan.

Replacing a Plank Bridge Deck With Grating

After a heavy truck broke through the plank floor of a 132-foot bridge spanning the Mohawk River in Rome, N. Y., officials of that city and a representative of a steel decking manufacturer joined forces to effect a speedy and permanent repair. G. Lyle Stillman, City Engineer, believes that the following schedule for the repair job sets some sort of a record:

Sept. 16—Heavy truck broke through plank floor.
Sept. 17—Representative of Irving Subway Grating Co. inspected bridge and estimated repair cost; City Common Council approved work at a special session.
Sept. 18—Order for decking material placed.
Sept. 22—Twenty-two tons of decking delivered to bridge site.
Sept. 27—Completed floor open to traffic.

The entire repair job was done by employees of the Public Works Department, under the direct supervision of John H. Byrnes, Superintendent of Streets. It was the first time this type of construction was undertaken by city forces.

Testing Pavement Resistance to Skidding

Nine months of research was recently completed by the Virginia State Highway Department on the skid resistance of the various types of highway surfaces making up the state highway system. Of 32 types of surfaces tested under varying conditions and speeds, 27 showed satisfactory skid resistance when wet, while all were satisfactory when dry. More than 1000 tests were made. Speeds were 10, 20, 30 and 40 miles an hour. Four types of tires were used: synthetics with good treads and with worn treads; and natural rubber with good treads and with worn treads.

It was again demonstrated that forward skidding distance increases considerably with speed, and that all skids are much longer on wet surfaces than on dry. At 40 mph., skid lengths ranged from 63.6 to 88.9 ft. on dry surfaces; and 72 to 254.5 ft. on wet surfaces. A harsh or sand-paper type of surface was found to have the shortest stopping distance. Application of non-skid treatment to smooth surfaces materially reduced the length of skid. In one case, the skid length on a wet surface at 40 mph. was reduced from 224 ft. to 94.7 ft. by the application of a non-skid surface material.

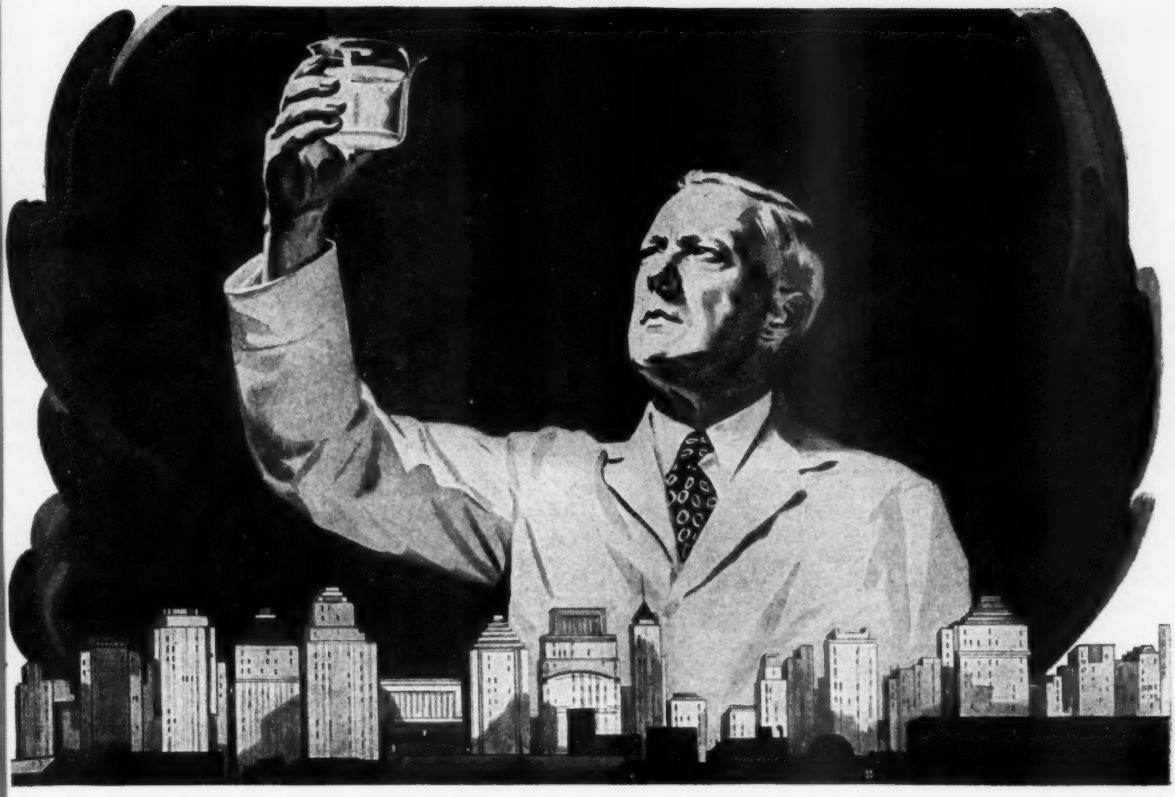
It was also found that at 40 mph. on wet surfaces, stopping distances were about 40% longer for worn than for good tread. Under comparable conditions, stopping distances were about 12% longer with smooth synthetics than with smooth or worn pre-war natural rubber tires. The purposes of the study was to obtain data on surface characteristics that could be used as a guide for establishing future design, construction and maintenance policies. Tests were conducted on high-type pavements mainly, including bituminous concrete, sand-asphalt, special plant-mix, rock asphalt, sand and slag seal treatments, broom drag treatments, portland cement concrete, and glazed bituminous surfaces. The tests were made by T. E. Shelburne and R. L. Sheppe, working under the general supervision of Shreve Clark, engineer of tests. The data in the survey were reported by Mr. Shelburne at the recent Highway Research Board meeting.

Costs of Municipal Parking Lots

Inquiries sent to a number of cities by the International City Managers Association brought reports from 30 cities showing the capacity and land and improvement cost per car of municipal parking lots, as follows:

City & State	*No. of Lots*	*Capacity, Cars*	*Cost Per Car*
Albuquerque, N. M.	1	250	$240
Anaheim, Calif.	2	86	151
Benton Harbor, Mich.	6	815	61
Chambersburg, Pa.	2	133	224
Fort Atkinson, Wisc.	2	200	75
Freehold, N. J.	2	400	65
Galesburg, Ill.	1	200	80
Greensburg, Pa.	1	100	350
Hastings-on-Hudson, N.Y.	1	150	1,000
Independence, Kans.	1	40	225
Ithaca, N. Y.	2	175	423
Johnstown, N. Y.	2	170	106
Kalamazoo, Mich.	1	390	154
Kansas City, Kans.	6	686	451
Long Beach, N. Y.	1	250	1
Madison, Wisc.	2	150	327
Miami Beach, Fla.	4	905	413
Millburn, N. J.	2	175	256
Monroe, Mich.	5	270	167
Montclair, N. J.	5	470	268
Mount Kisco, N. Y.	1	100	200
North Adams, Mass.	1	140	429
Plymouth, Mich.	1	96	85
Port Huron, Mich.	3	550	93
St. Petersburg, Fla.	1	500	45
Sioux Falls, S. D.	5	400	312
White Plains, N. Y.	3	181	553
Whittier, Calif.	8	210	260
Winnetka, Ill.	5	394	388
Woodbury, N. J.	1	400	33

When you need special information—consult the ENGINEERS' LIBRARY on pages 63-65



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A French View of Runway Construction

In *Travaux* [1947, 31 (147), 5-12], J. de Larrard discusses requirements for concrete runways for heavy aircraft. The importance is stressed of a sufficiently high and constant subgrade bearing capacity; thus vibration is recommended as a means of compaction in preference to the use of pneumatic-tired rollers, and the need for deep drainage installations is emphasized as a means of preventing undue moisture-content fluctuations in the subgrade. With regard to the actual surfacing, it is recognized that joints are the main source of trouble, and the commonly employed remedies, dowelling or edge-thickening, are criticized. It is suggested that a concrete sill might be used at the joint some distance below the surface of the subgrade; this would prevent undue subgrade deformation at the joints. The following design and construction procedure is also recommended for consideration: after stripping the site, a thin course of impermeable material (possibly concrete) should be laid and borrow material spread over it and compacted, followed by the concrete surfacing, which may now be thinner than would be required by the Westergaard formulae. Thin walls should also be constructed along the edge of the concrete stretching well down into the subgrade; these would serve to prevent moisture-content fluctuation in the subgrade beneath the runway, and could also contain surface drainage installations, etc. Thus the subgrade would be disturbed as little as possible and would retain its natural bearing capacity. If the walls were constructed early in the operation, they could serve conveniently as forms for the base and surfacing.—From Aerodrome Abstracts.

Vacuum Test of a Sphere to Failure

In a test to determine the value of the coefficient k in the formula for the safe external pressure for hollow spheres, a Vaporsphere was selected because its characteristics were such that it was expected to fail with small damage at a relatively low pressure. This interesting test was reported in *The Water Tower*, a publication of the Chicago Bridge & Iron Co., for November, 1947.

The formula for safe external pressure is:

$$P = \frac{5}{3} k^2 \left(2 - \frac{k}{9}\right), \text{ where } k = \frac{100t}{D}$$

P is the safe pressure in pounds per square inch; t is the shell thickness in inches; and D is the diameter of the sphere in feet. The tank selected for the test had a diameter of 52.5 ft. and a shell thickness of 3/16 in. Using the above formulas, the safe external pressure would be 0.416 lb. per sq. in. Vacuum was applied to the tank and failure occurred through buckling of a plate at a vacuum equal to 1.2 lbs. external pressure per sq. in. Air was then admitted to the tank and when a small vacuum still existed, the buckled plate returned nearly to normal. Vacuum was again applied and again failure occurred by buckling of the same plate, but this time at a lower pressure (2.5 ins. of mercury for the first failure and 1.9 ins. for the second). When air was again admitted to the tank, the buckled plate again returned to position.

When you need special information—consult the ENGINEERS' LIBRARY *on pages 63-65*

Fort Wayne Operation

(Continued from page 23)

DO—Average DO in the mixed liquor was 4.4 ppm; maximum, 8.1 ppm; and minimum, 2.2 ppm. DO in the final effluent ranged from 4.5 to 4.7 with 47% to 48% saturation. DO in the stream above the plant was 8.9 and below the plant, 8.0. BOD above the plant was 3.4 ppm, and below the plant 5.3 ppm.

Raw Sludge.—Sludge amounted to 43.292 Mg with 3.95% solids and 63% volatile; pH averaged 6.29. Total gas production was 66,569,000 cu. ft. The pounds of volatile raw sludge totaled 8,414,000 pounds; cu. ft. of gas per pound of volatile was 7.9. Sludge averaged 119,000 gals. per day. The working capacity of the digesters was 2,300,000 gallons, giving 21 days theoretical digestion. Raw sludge averaged 10,000 gallons per draw, and was drawn 12 times daily.

Waste Activated Sludge.—There were 84.83 Mg of waste activated sludge with 1.00% solids and 70% volatiles; the pH was 7.02. All sludge was returned to the wet well. Suspended solids removed in the secondary was calculated at 7,600,000 pounds; activated sludge wasted was calculated at 7,100,000 pounds.

Supernate.—This totaled 8.716 Mg with .33% solids and 56% volatiles. It was returned to the wet well or primary tank. This was 20% of the raw sludge pumpage. In 1947, the sequences of digester operation was changed from two-stage to single-stage. Also one of the 3 Mg lagoons was converted into a supernate lagoon with provision for surface draw-off. Surface drainage from this lagoon dribbles back to the plant. For the first nine months of 1947, good supernate returned to the primary tank totalled 9,856,000 gallons of .18% solids. Total liquid to supernate lagoon, some good supernate, some heavy sludge, for the same nine months, totalled 9,350,000 gallons. Total dribbling back to the plant was 6,350,000 gals. This is a nine-month total of 16,206,000 gallons of good supernate or 43% of raw sludge pumpage. Surface drainage from supernate lagoon ran 200-400 ppm solids, 100-400 ppm BOD.

Digested Sludge.—There were discharged 34,256 Mg to beds and lagoons; 3.25% solids; 45% volatile; pH 7.27.

BOD Removal.—Total BOD removed in secondary, 8,329,000 pounds; total air, 5.345 Bcf; pounds BOD per 1,000 cu. ft. of air, 1.56; cu. ft. of air per pound BOD, 642. Total out-of-pocket cost (power, salaries, supplies) per 1,000 pounds BOD removed was $14.14.

Per Capita Per Day.—Sewage flow, 144.0 gallons pcpd; raw sewage solids, 0.279; raw sewage BOD, 0.236; raw sludge, 0.296; volatile raw sludge, 0.177; gas production, 1.40 cu. ft. pcpd. All of these data are based on Chamber of Commerce estimate of 130,000 population. Population equivalent is 181,000.

Average Basin Detention. — Primary 1.2 hours; aeration 6.9; secondary 2.8; total plant 10.9.

Treatment Costs. — Total "out-of-pocket" costs amounted to $117,686.54. This includes all charges, salaries, wages, electric power and supplies, except interest and depreciation. The $117,686.54 is divided as follows: $75,328.63 for labor; $26,542.80 for power; other costs $15,815.11. This amounts to $17.19 per Mg of raw sewage, divided as follows: $11.00 for labor, $3.88 for power, and $2.31 for supplies. Since raw sewage pumpage was $2.57 per Mg, this leaves $1.31 per Mg for electric blower operation and small motors and lights.

PUBLIC WORKS DIGESTS

Sewerage

Water Supply

Highways and Airports

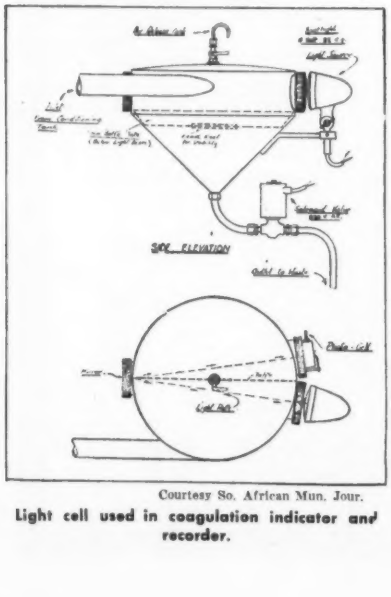
This section digests and briefs the important articles appearing in the periodicals that reached this office prior to the 15th of the previous month. Appended are Bibliographies of the principal articles, in which the articles in each periodical are numbered consecutively throughout the year, beginning with our January issue.

The letter and number at the end of each item refer to those used in the Bibliography. Numbers not found in the current Bibliography will be found in the one published the previous month.

The Water Works Digest

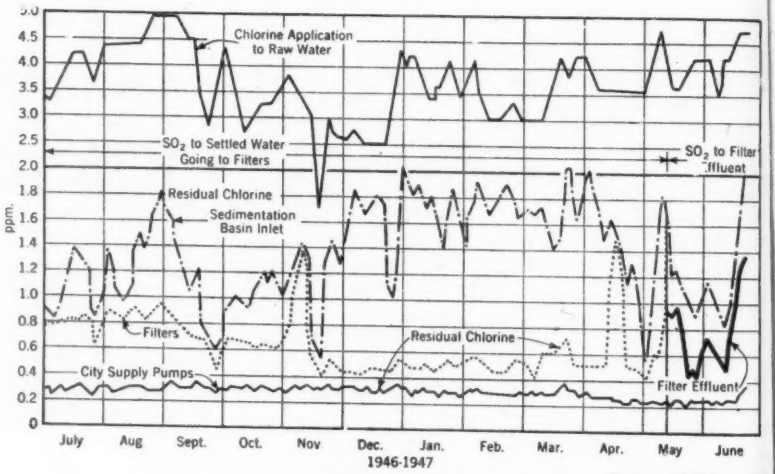
Photo-Electric Coagulation Indicator

The city engineer of Cape Town, South Africa, has designed and used a photo-electric coagulation indicator and recorder which indicates and records, at 20-minute intervals, the clarification of the water as actually being conditioned. A sample of water is drawn from the conditioning tank to the device soon after the addition of the coagulant and allowed to stand for 20 minutes, when the clarity of its upper structures is measured by means of a light beam shining through the water onto a photo-electric cell. The device consists of a settling tank 14" in diameter, 3½" side depth with a 45° cone-shaped bottom; into which the treated water is introduced tangentially through a 1½" pipe, and is drawn off 20 min. later by a pipe in the bottom of the hopper; both supplying and withdrawing of water being controlled automatically by means of a timing device and solenoid valves. A 6-volt 32 cp. lamp throws its ray through the top of the settling tank to a mirror, which reflects it back to a photo cell (thus doubling the length of the light path); the lamp being turned on automatically for ½ minute at the end of each 20-min. cycle. The photo cell is wire connected to a recording potentiometer, which is adjusted to read 100% when the water is entirely free of floc and 0 when the maximum amount of floc is in suspension. A "floc index" is determined, being that when a satisfactory filter effluent is maintained; and when the index rises above this, the alum dose is reduced; or if it falls below, the dose is increased. The index instantly shows the effect of varying the pH of coagulation. Thus the optimum pH and the minimum alum dose for any particular raw water condition can be determined in a few minutes.[T1]



Courtesy So. African Mun. Jour.

Light cell used in coagulation indicator and recorder.



Courtesy AWWA Journal

Super- and dechlorination records at Dalecarlia.

Superchlorination and De-chlorination

Superchlorination of water, with or without de-chlorination, is effective in removing most tastes and odors, and furnishes additional protection against water-borne diseases. De-chlorination can be effected by several chemical reagents or by filtration through granular carbon. If the complete chlorine demand is satisfied and chlorinous tastes and odors are not objectionable, de-chlorination may be unnecessary unless the effect of free chlorine on manufacturing processes must be considered.

Sulfur dioxide is the reagent most commonly used, chiefly because of cost. In applying it, special evaporators are needed; one type uses live steam fed directly into the bottom of the evaporator bath; another consists of electrical equipment; each controlled to maintain an operating temperature of about

190°F. Partial oxidation of the sulfurous acid by the dissolved oxygen in the water causes the formation of sulfuric acid, which combines with the alkalinity without affecting the free chlorine. Super and de-chlorination of a normally alkaline water results in a slight increase in calcium chloride and calcium sulfate hardness, and a decrease in carbonate hardness. The water treated must be sufficiently high in alkalinity to prevent the formation of sulfuric and hydrochloric acid. Careful laboratory control is essential for effective prevention of tastes and odors. The cost of super- and de-chlorination compares favorably with most other methods of corrective treatment.

De-chlorination by passing superchlorinated water through beds of granular carbon has been used successfully in several places in this country and in Europe. [A12]

At Washington's Dalecarlia plant, sulfur dioxide was fed from 1-ton containers through rotameters and vacuum type chlorinators. For a time, trial was made of using sulfur dioxide in the solid form of sodium metabisulfite, which is readily soluble, using a 30% solution, fed by ordinary proportioning feeders through rubber-lined pipe. During the winter of 1946-47 a little over 1ppm of chlorine was removed. One part of chlorine was removed by one part of sulfur dioxide. (Theoretically 0.9 part of sulfur dioxide should remove 1 part of chlorine). In passing through the filters there was further absorption of chlorine and an increase in chloramine residual. At first the sulfur dioxide was applied between the sedimentation basins and the filters; but early in May the application point was changed to the filter effluent, which makes it easier to maintain free chlorine residuals without excessive overdosages in the water going to the city.

This treatment produces tasteless and odorless water with low residuals and almost perfect bacterial efficiency. [A11]

Steel Pipes Lined in Place

Since 1935, Newark, N. J., has lined 137,000 ft. of steel pipe and 13,000 ft. of 36" cast-iron pipe with cement mortar, using three different methods; 1—the "Perkins" machine, developed by the T. A. Gillespie Co. and now owned by the Centriline Corp.; 2—hand-applied and hand-finished gunite; and 3—the "Crone" machine, developed and used by the Preload Corp. Accurate tests of the steel pipe lines, made after reconditioning, showed that they had been restored to more than their original capacity, due to the fact that the linings, ⅛", ⅝" and 1" thick, eliminated the obstructions caused by the riveted joints. These lines now deliver 80 mgd, while prior to lining they delivered only 46 mgd. There has been no diminution of capacity of these since lining, some of which was done 11 yrs. ago; in fact, there has been a slight increase. The only indications of rust have been on the tops of a few rivet heads which the lining did not cover. Test pieces of lining cut out from work done 11 yrs. ago and tested showed that, to a depth of 1/20 in., the lime content had been reduced from the original 26% to 5%, and the iron and aluminum oxide increased from 4.3% to 11%. Tests of lining for tensile strength showed this to range from 513 to 690 psi.[A3]

Reducing Unaccounted-for Water

The first factor in this is to be sure that the means used for measuring the water delivered to the system and that accounted for are accurate. This requires universal metering, properly proportioning the size of each meter to rate of consumption, and maintaining accurate registration by the meters. If this accurate measuring shows an undue loss, a leakage survey is in order. One entirely metered system sells 82% of its water in addition to that used for flushing streets, fighting fires, etc. The Wilkinsburg-Penn Joint Water Authority meters all customer services and all water delivered by each pump; also the water leaving each of four reservoirs. Meter records for the past 7 years account for all but 10% of the water, with no allowance made for fire protection, hydrant flushing, evaporation from four open reservoirs, meter slippage or other unmetered demands.[A5]

Gravity Flocculation

Gravity flocculation requires no special machinery, but only about 2 ft. additional lift by the raw-water pumps. The under-and-over type of baffles is generally preferred to the around-the-end type. A 30 to 60-minute flocculation period permits reducing the settling tank size to give 4 to 2 hr. settling time if properly proportioned and provided with multiple take-off weirs; submerged weirs should be eliminated. The over baffles should be raised ½ in. above the floor. The baffle nearest the settling tank should be an over baffle. The first over baffle should have sufficient freeboard, using the submerged weir formula; each succeeding over baffle being 2" lower. The opening under the first under baffle is designed as an orifice to produce a velocity not greater than that used in computing the baffles of the first section; each succeeding baffle being raised 1" to 2". This velocity, for treating up to 2 mgd, should be 1.5 fps in the first of three sections, 0.5 fps in the second section and 0.125 fps in the third section. For treating more than 2 mgd, divide it into 4 sections, in which the velocities are made 1.5, 0.75 to 0.55, 0.33 to 0.25, and 0.125 to 0.10 fps, respectively. Spacing of baffles, in feet, generally equals $Q \div CWV$, in which Q is flow in cubic feet per sec.; W is width of channel (generally 2 to 6 ft.), V is the selected velocity; and C is a coefficient, generally 0.60 to 0.75. For quantities exceeding 10 mgd, special studies should be made for determining all these details.[P1]

Rules and Regulations For Water Works

The author believes that "written rules and regulations are important tools for the operation of a water works utility." Their main purposes are to complete the service contract with customers, to set forth the conditions of service, to state the utility's obligation to the customer and the reverse, and to cite the utility's authority for its prohibitions and requirements.

Replies of fifteen utilities to a questionnaire showed a general agreement that standardization of rules and regulations is impracticable. However, all have certain logical subdivisions: 1. Fundamental matters such as rates, billing practices, service and meter ownership and maintenance, discontinuance and restoration of service, access to premises, misuse of hydrants, penalties for violations and the like. 2. Standard practice rules relating to the arrangement of mains, services and meters. 3. Prices on work performed for the customer or for others. 4. Water main extension rules. Considering the subject of mains, services and meters, suggested subdivisions include the questions of services or private mains in alleys; services across private property; services along street axis; more than one customer per service; double-header services; joint service branch to commercial buildings; multiple metering; combining meter readings for billing purposes; purchase of water for resale; and ownership of mains on private property.[A1]

Testing Meters in St. Paul, Minn.

The St. Paul Water Dept. in 1946 disconnected 4678 meters of 2" and under for the following reasons: Burnt 594; frozen 137; defective 529; sand 515; register defective, 515; leaking 1276; service shut off 208; tested on request 125; disconnected to drain system 54; plumbing change 311; noisy 76; poor pressure 2; periodic test 192; not justified 144. Of meters 3" and larger, 1 was stopped by sand, 1 frozen, 1 leaking, 1 for plumbing change, 9 for service being shut off, and 14 for periodic testing.

After a meter has been tested it is rinsed in hot water, immersed in a diluted solution of Oakite No. 32, again rinsed in hot water, and dried by a stream of compressed air. Repaired meters are sprayed with a weather-proof aluminum paint in an enclosure provided with a ventilating fan.[P1]

Freezing Service Pipes for Making Repairs

When it is necessary to stop the flow in a service pipe without closing a valve or using a rubber plug, this can be done

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by freezing the pipe at any convenient point. Doing this by use of ice and salt is an old practice. Use of dry ice is more convenient and quicker. The author uses a piece of rubber inner tube about 8"x10" and, using strong paper clips or clamps, makes a pocket about the spot to be frozen. A piece of dry ice about the size of a tennis ball is pounded into powder, placed in this pocket so as to surround the pipe and about a ¼ pt of alcohol is poured onto and stirred with it. The flow in the pipe is stopped entirely or as nearly so as possible, and a plug will be frozen solid in 5 to 10 min. and will continue frozen so long as there is any dry ice in the pocket. When the job has been completed the ice plug can be thawed with hot water.[F2]

Covering Reservoirs

In a distribution reservoir of the Philadelphia, Pa., water supply, the following undesirable conditions were noted:

1. Moss growths, leaves, weeds, micro-organisms, all of which upon entering distribution would rapidly decompose (particularly the micro-organisms), furnishing great quantities of ideal foods for bacterial growth, also producing tastes and odors
2. Train soot, road dust, run-off, contributing direct pollution.
3. Fish life, rodents, bird droppings, contributing direct pollution.
4. Swimming, drownings, contributed direct pollution.
5. Temperature increase in summer.
6. Bacterial action at the higher temperature causing the floating of deposits.
7. Loss of chlorine residuals.

"This reservoir is no exception,—just check the score on your own, if you have one on your system.

"Protection and maintenance of open reservoirs, treatment for algae control and re-chlorination all are more or less expensive and can, at best, overcome only to a limited degree many of the undesirable features mentioned. When these costs are balanced against the carrying charges for covering, I believe it will be found that many distribution reservoirs could be covered, producing a net saving as well as eliminating dangers of pollution, disagreeable conditions, and a nuisance to the water superintendent." [X2]

Disposal of Filter Wash Water

Wash water and sludge from filters contain only what was carried by the raw water plus chemicals added in the treatment process, and if discharged into the source of supply have little effect upon it except to increase the concentrations therein of the matters filtered out. The ways by which these wastes can be disposed of include: 1. Direct discharge into the stream without treatment of any kind. 2. Discharge of all wastes into the sewerage system. 3. Discharge of wash water into sewers and sludge into lagoons or sludge beds, which are excavated after drying and used for filling low land. 4. Discharge of both wash water and sludge into a settling basin, permitting the settled water to overflow into the stream and emptying the sludge into the stream at periods of high water. 5. Discharge of wash water directly into the stream and sludge into a lagoon or sludge beds. 6. Direct discharge of both wash water and sludge into lagoons which overflow to the stream. 7. Pumping of all wastes back into the reservoir. 8. Discharge of wash water and sludge into a settling basin and pumping of the settled water back to the plant, the sludge to be disposed of either in lagoons, on sludge beds or by dewatering in vacuum filters.

These methods can be varied or combined. Difficulties have been reported with odors from sludge in lagoons or sludge beds.[A8]

Performance of Transite Water Main

Winnipeg, Manitoba, in 1932 laid 1183 ft. of 18" and 14" Class C Transite pipe along a route where the soil was particularly aggressive because of its high content of sulfates of sodium, magnesium and calcium. After 14 yr. of service the manufacturer of the pipe, with the city's cooperation, tested this pipe to learn its flow coefficient nad its strength against hydrostatic pressure and crushing.

The flow test was made by the Pito-

meter Co., which reported that eleven test runs showed a Williams & Hazen C of 140, indicating little if any loss of capacity since 1932. Three 9-ft. lengths of the pipe were cut out of the main, one containing a Simplex coupling. The section containing the coupling was tested under 260 lb. hydrostatic pressure—4 times the normal working pressure, with no sign of leakage. Two other lengths were subjected to 325 and 430 lb., respectively, before failing. A 12" length was tested by the 3-edge bearing method and failed at 10,260 lb. A ¾" corporation stop was screwed into a pipe and subjected to a pull of 4,610 lb. before it broke out.[G1]

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4. Equipment and Procedure for Long Line Hydraulic Studies. By Fred C. Scobey. Pp. 1191-1203.
5. Reducing Unaccounted-for Water. By Chares Haydock. Pp. 1204-1210.
6. Lime and Lime-Soda Sludge Disposal. By Wm. W. Aultman. Pp. 1211-1215.
7. Brine Disposal From Sodium Zeolite Softeners. By Paul D. Haney. Pp. 1215-1219.
8. Disposal of Wash Water From Purification Plants. By Harry R. Hall. Pp. 1219-1223.
9. Erosion Control in Los Angeles Watersheds. By Burton S. Grant. Pp. 1224-1228.
10. Erosion Control in East Bay Watersheds. By Francis B. Blanchard. Pp. 1229-1236.
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1. Performance Record of 14-Year-Old Transite Water Main at Winnipeg, Mani. By W. D. Hurst. Pp. 391-396.
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Effect of DDT On Fish, Fish Food and Plankton

ACCORDING to the U. S. Public Health Service, which has been studying the use of DDT at the Carter Memorial Laboratory, in South Carolina, the application of DDT in amounts normally necessary for mosquito control is not "significantly harmful to (certain) other organisms of economic or recreational value."

Effect on Fish: Applications of tight emulsions and solutions at the rate of 0.4 pound DDT per acre, or more, were detrimental to fish in shallow water. Single applications of dusts and solutions at the rate of 0.1, 0.05, or 0.025 pound DDT per acre caused no observed fish mortality. Repeated treatments at 0.1 pound per acre caused fish mortality between the third and tenth treatments, and the fish population was significantly reduced by a series of from 11 to 18 treatments in the ponds studied. It was indicated that routine treatments should not exceed 0.05 pound DDT per acre for small or shallow bodies of water. Repeated applications at this rate caused mortality to fish in shallow ponds in which the entire area was treated. It is believed that mortality will not be significant in larger, deeper waters in which only the margins are treated. In

areas similarly treated with 0.025 pound DDT per acre no fish mortality was observed.

Effects on Surface Organisms Important as Fish Food. Several different formulae, methods of application, and concentrations of DDT were used in connection with experiments on more than 20 ponds. The methods used for determining the effects of treatment included quantitative sampling of the surface forms and counts of dead organisms on the water surface 24 and 48 hours after treatment.

Gross observations indicated that little apparent damage to surface organisms resulted from application of DDT as a dust. The seasonal trend of the population of surface organisms was somewhat affected by repeated treatments with dust at the rate of 0.1 pound of DDT per acre, but the changes were not as great as those caused by treatments with solutions of DDT in fuel oil.

DDT-fuel-oil solutions applied at concentrations as low as 0.025 pound of DDT per acre killed the large surface insects such as diving beetles. (Dytisidae), whirligig beetles (Gyrinidae), water scavenger beetles (Hydrophilidae), and water boatmen (Corixidae). Mortality resulting from applications of 0.05 or 0.025 pound per acre were proportionately much less than when applications of 0.1 pound per acre were used. Single treatments produce few significant changes. A comparison of the populations of surface organisms in the treated and check ponds indicated that seasonal effects of routine DDT treatments were quite marked. There was an increase in the number of hermaphrodite worms (Oligochaeta), nematodes (Nematoda), and copepods (Copepoda), and a decrease in midges (Chironomidae), true bugs (Hemiptera), beetles (Coleoptera), and May flies (Ephemerida). The number of insects as a group decreased in the treated ponds with the largest decrease occurring among the midges.

It would appear that the available supply of fish food is somewhat reduced by applications of DDT-fuel-oil solutions. The forms that increase in numbers are much fewer than those that are reduced in number by DDT and in general they are not as readily taken by fish. Reductions have not been sufficient to effect breeding stock, and since treatment is carried out in localized areas, the resulting restriction of food supply is probably not sufficient to limit seriously the over-all fish population.

Effects on the Plankton. Plankton is the chief food source for several species of adult fish and for most young fish. In order to determine the effect of DDT dispersal on plankton, ponds were selected on the basis of total population, physical and ecological similarity, and availability on control areas. DDT was applied as a dust, or as a solution in fuel oil. The concentrations ranged from 0.2 pound to 0.05 pound per acre of water surface. Weekly treat-

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ments were made over periods of from 6 to 18 weeks. Samples of plankton were taken prior to and 48 hours after treatment.

The studies indicated that the detrimental influence of DDT (as used for the control of malaria vectors) is so slight, in comparison with the larger variations due to climatic and other ecological factors, as to be relatively unimportant in upsetting the biological balance. No specific groups of plankton were drastically affected by DDT treatments during the course of the experiments. A few groups showed a slight reduction, but in no instance were they reduced to any marked degree. It appears that the use of DDT as a mosquito larvicide will be restricted more by its potential dangers to the fish and the higher forms of life directly than by any harmful effects on the plankton.

Effect on Birds. Airplane applications over a period of 17 weeks, using a 20% solution of DDT in a highly methylated napthalene applied at the rate of 0.1 lb. per acre per treatment to areas of the Savannah River Refuge, did not indicate any harmful effects on the bird population. There was no significant difference in the sprayed and unsprayed islands. There was no sudden drop or general decline in the bird population of the sprayed areas. Apparently DDT had no measurable effect on birds.

Effect on Mammals. No effect could be detected on the population of the cotton rat or house mouse in the sprayed areas. Calculated on a weekly basis, the fluctuations in the numbers of cottontail rabbits, cotton rats, and raccoons, on sprayed and unsprayed areas from 13 May to 30 August, roughly paralleled each other, indicated no effect on the mammals in the sprayed areas.

For fuller data see Public Health Reports, April 11, and August 29, 1947.

USPHS Water Sanitation Practice

A new Manual of Recommended Water-Sanitation Practice (Public Health Bulletin No. 296) is available. The material was originally prepared for use by Public Health Service sanitary engineers in evaluating sanitary features of water supplies with which they are concerned, but it may also be useful to state, city and county health departments and other agencies. The publication was prepared by Public Health Service's Sanitary Engineering Division, including the Water and Sanitation Investigations Station in Cincinnati, Ohio, in cooperation with State sanitary engineers and others. Procedures outlined in the manual are not mandatory, and do not rule out other practices.

The manual covers the physical features of water supply systems and their sanitary protection; recommended sanitary requirements for water treatment and water distribution systems; and chemical and bacteriological requirements for potable water. A limited number of free copies are available, for persons directly engaged in water works sanitation, from Public Inquiries Section, Office of Health Information, U. S. Public Health Service, Washington, D.C. Copies in quantity can be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 15 cents per copy.

Dedication of MIT Laboratories

The William Thompson Sedgwick Laboratories of Sanitary Science were dedicated in the Department of Civil and Sanitary Engineering at the Massachusetts Institute of Technology on December 3. Dr. John B. Wilbur, head of the department, presided at the dedication program. Other speakers included Dr. Samuel C. Prescott, Arthur D. Weston and Dr. Gordon M. Fair of Harvard. Prof. W. E. Stanley described the new facilities and the work they will do. Dr. Murray P. Horwood is in charge of the laboratory of sanitary bacteriology and research; Dr. Clair N. Sawyer of the laboratory of sanitary chemistry; and Prof. Ariel A. Thomas of the laboratory of sanitary engineering.

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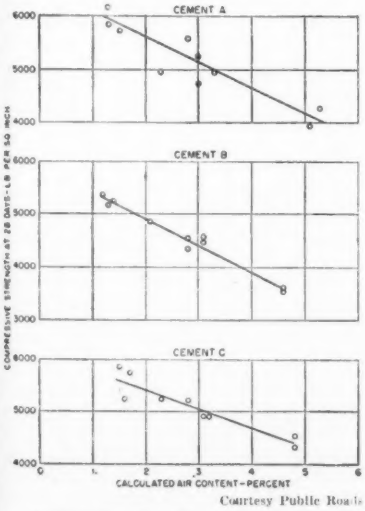
The Highway and Airport Digest

Blending Natural And Portland Cements

Some natural cements contain sufficient air-entraining material to produce air-entraining concrete when blended with portland cement, while others produce little or no additional air. The entrained air in concrete increases its resistance to freezing and thawing, at the same time producing other effects, such as reducing strength. A study has been made by Public Roads Administration of the flexural and compressive age-strength relations, the drying shrinkage, and resistance to freezing and thawing in water, the effect of initial curing, and the effect of segregation of the constituent materials due to manipulation of the surface in the finishing operations. The tests were made with 7 natural cements and a slag cement, each blended with each of three plain or non-air-entraining portland cements. All blends were made in the proportion of 14% natural cement to 86% portland, equivalent to one bag of the former to 5 bags of the latter. Some results of the tests were as follows:

All air-entraining mixtures produced more workable concrete than those containing only small quantities of air. For air contents in excess of 2%, the compressive strength was reduced approximately in proportion to the increase in amount of entrained air, the greatest reduction being about 30% in 7 days, reduced to 24% in 180 days. (Portland cements made air-entraining by Vinsol resin interground with them, when compared with the same cements without Vinsol, showed 13% less strength at 3 days, reduced in 180 days to 5% with one cement and a slight increase in another.) In drying shrinkage, there was no outstanding difference between any of the cements or blends tested. Slabs were screeded, belted and cured for about two years, and disks cut from their tops and bottoms were subjected to alternate freezing and thawing in a 10% calcium chloride solution. In 85% of the samples the bottom disks showed more resistance to freezing and thawing than the top ones, but the difference was less for the air-entrained cements than for the others.[U2]



Courtesy Public Roads

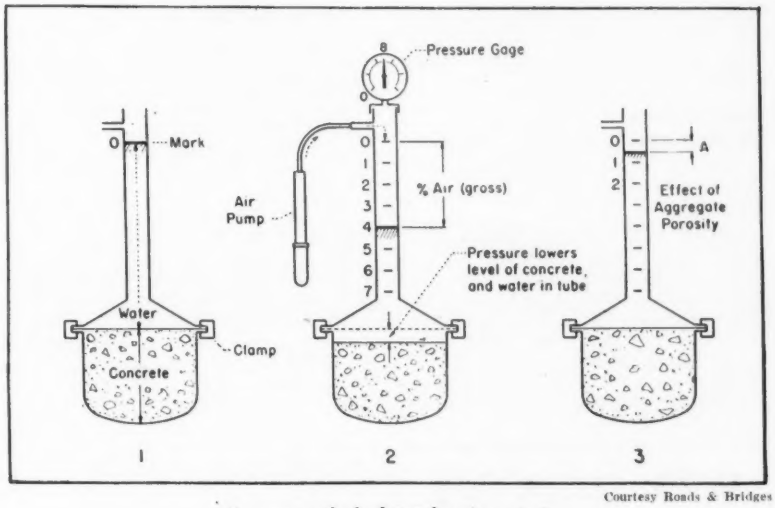
Compressive strength and air content.

Air Entrainment In Concrete

There are many factors affecting the air content of concrete. Among the principal factors are the amount and gradation of the sand used in the concrete. A sand with a preponderance of the 30 to 50-mesh and 50 to 100-mesh sizes will entrain more air than a sand lacking in these sizes. Also, a sand manufactured by crushing may contain a considerable percentage of particles passing the 100-mesh sieve and even the 200-mesh sieve. These very fine particles inhibit air and greatly reduce the air-entraining effectiveness of a sand. An increase in the sand content will increase the amount of air in concrete.

The water content of the concrete has a pronounced effect upon air content; an increase in slump of 1½ in. to 2 in. can well account for an increase in air content of from 1½ to 2%.

The condition and speed of the concrete mixer have an effect on the air content of the concrete. With greater agitation in the mixing operation, a higher air content will result.



Courtesy Roads & Bridges

Pressure method of test for air content.

There are three methods of measuring entrained air in concrete. The one most used by highway departments is the pressure method, the apparatus for which functions on the principle of Boyle's law, that the volume of a mass of gas is inversely proportional to the pressure upon it.[O4]

Building the Maine Turnpike

A general description of this was given in the *Digests* for September and November. Some construction details are given herewith.

About 1,360,000 sq. yd. of high type hot-mix, hot-laid asphaltic concrete was placed this year—said to be the greatest yardage ever placed on one job in a single season. Maximum daily output exceeded 6,500 tons. The paving was essentially completed in October, in two contracts.

A 5" or 6" base course was laid in two layers, using crushed gravel up to 2", with 4.7% asphalt. The 2" top was composed of crushed stone, as much as 40% between ⅜ and ¼ in size, and 6% asphalt. On the south contract separate plants were set up for the base and for the top mix. A 3-unit portable crushing and screening plant supplied 200 tons per hr. of gravel, consisting of a bar grizzly, a 10" x 36" jaw crusher and 40" x 24" roll crusher. Aggregates were screened into 4 sizes and recombined and mixed with bitumen in a pug mill.

Stone for the top course was crushed in two jaw crushers, a gyratory and

a roll crusher, divided into three sizes, recombined and mixed with 6% asphalt in batches in a pugmill. Pavers placed two 12-ft lanes at the same time, one machine operating just behind the other; then the two top layers, 11 ft. and 13 ft. wide respectively to break joint with the lower. The surface course was laid in two 12 ft. lanes simultaneously so that both would be hot along the longitudinal joint. It was rolled with two 15 to 18-ton 3-axle tandem rollers.[E2]

Classification Of Airports

Civil Aeronautics Administration in November ordered all airports classified by purpose as follows:

Feeder Airports — Runways 3500 x 100 ft., loading 15,000 lb.; Local airports—runways 4,200 x 150, loading 30,000; *Express Airports*—runways 5,000 x 150 ft., loading 45,000 lb.; *Deluxe Airports*—runways 5,900 x 150, loading 60,000 lb.; *International Airports*—runways 7,000 x 200 ft., loading 75,000 lb.; and *International Express Airports*—runways 8,400 x 200 ft., loading 100,000 lb.

These lengths are for sea level, and are to be increased 7% for each 1,000 ft. of elevation, and by 0.5% for each degree by which the mean temperature of the hottest months exceeds 59°F.[E1]

Paving Without Cost to the City

Many recently opened streets in Carlsbad, N. M., needed paving, but the city did not feel able to do the work, so a local contractor contracted with the property owners to do it, according to city specifications and under city inspection, and the city assumed the maintenance. The city sets the grade stakes and furnishes the curb and gutter forms, so that grades and types of curb are uniform with the city standards. The pavement is 2" of asphalt mixed-in-place concrete on a 6" base of caliche rock. The caliche is broken to 4" or smaller, dampened and spread in three 2" layers, each layer rolled with a sheepsfoot roller to a compaction of 95%. The curb and gutter cost the property owners $1.25 per lineal foot, and the paving $2.25 to $2.80 per front foot.[P1]

Road Drainage By Means of Sumps

Of a 5.2-mile road project north of Miami, Fla., about 3 miles consists of two 30.5-ft. roadways separated by a 14-ft. grassed median strip, from which they slope to side gutters. The ground is nearly flat, elevated only slightly above sea level, and there are no nearby streams to receive the runoff. Underlying the top soil is a porous lime rock, and the runoff from about a mile of the roadways is carried to sumps in this rock. The flow through the walls and bottom of one sump was found to be about 800 gpm. Catch-basins at 300 to 500 ft. intervals along the outer edge of each pavement receive the water, which then flows through 15" pipe to sumps located about 500 ft. apart along the center line of the median strip. Each sump is 16 x 4 ft. by 4.5 ft. deep with a 6" cover of soil. At another section of the highway where the porous limerock is below the water table, instead of a sump they are laying 100 ft. of open-joint 18" pipe along the center line of the median strip with the top of the pipe about 6 ft. below the surface. Thirteen of these pipe drains are being laid.[E3]

Mechanical Equipment Reduces Cost of Construction

The cost of common excavation was more than 40 ct. a cu. yd. in the days of hand labor and animal power. It had dropped to 34 ct. at the beginning of the diesel area in 1928, and to 21 ct. by 1940 through refinements in design of machinery. This in spite of the fact that wages and prices increased greatly during this 20-year period.

In scraping operations, two-horse wheelers before 1923 handled 2.85 yd. an hour at a haul of 800 ft., and three 1½-yd. wheelers with a 60-hp. tractor handled 22.4 yd. in 1924-1928. In the final prewar stage, 1934-1940, 14-cu. yd. carry-type scrapers with 95-hp. tractors moved 53 yd. per hour with a 1,500-ft. haul, while a 23-cu. yd. scraper, with 95-hp. tractor and pusher, moved 68 yd. per hour with a 2,000-ft. haul. It will be observed that the scrapers of 1940 delivered 46 times as much earth at 800 ft. as was moved prior to 1924. Furthermore the economic length of haul for scrapers increased from 600 ft. to 2,500 ft.[N6]

Tunneling Under a Street

To carry central heating pipes across Cleveland's busy Carnegie Ave., a distance of 100 ft., without interfering with traffic, the city jacked across the street a 3 ft. tunnel 5 ft. below the surface, clearing other underground utilities. Jacking was done in a pit 6½ x 15 ft. dug on one side of the street. The pipe used was Armco 8-gage spiral welded iron casing, covered with a metal jacket to prevent injury to the galvanized coating. One man at the head of the tunnel did the excavating, placing the dirt in a small hand car, which was pulled back when full, and emptied. The steam lines placed in the tunnel were "Ric-Wil" insulated pipe units. The project was completed in three 24-hr. working days, at considerably less cost than the usual open cut method.[J2]

Taking Soil Samples

In making soil surveys for highway and bridge projects in California, 1" core samples are usually taken; using hand equipment unless the depth exceeds 40 ft. or more, when 2" cores are obtained by use of a power rig. The hand equipment commonly used consists of cutting points outside, extension rods, driving rod and plug, inside extension rods, driving head, drop hammer, gasoline hammer, pulling jack, and 6" brass tube sample retainers. This is sufficient for borings up to 50 ft. For a depth of 8 ft. or less, the outside rods and gasoline hammer are not used.[N2]

Mowing Roadsides

Mowing roadsides of state and county highways is rapidly being motorized. The highway department of Texas owns 400 power mowers, 300 bought since the war; Iowa owns 360, Virginia 206, New York 200, and six other states of twelve reporting own more than 100 each. The total for the twelve is 2,097, of which more than 850 have been bought since the war.

Minnesota maintains 11,000 miles of trunk highways, and uses 542 mowing machines, of which 277 are converted agricultural mowers, which are drawn behind trucks. The department also

uses 177 one-man power mowers, self propelled but guided by a man walking behind. Also, a large number of power mowers and horse-drawn mowers are employed on an hourly basis. Weed-killing chemicals are being used increasingly to kill weeds in inaccessible places and those agriculturally objectionable.[N3]

Hauling Concrete in Trucks

On a job of laying 5,500 cu. yd. of concrete pavement last summer in Milwaukee, the contractor obtained the air-entrained concrete from a central mixing plant, from which it was hauled 5 miles in 4-yd. "Dumpcrete" bodies, averaging 63 min. for the round trip. The concrete was not agitated in the trucks, but the segregation, if any, that may have taken place was remedied by the re-mixing effect of the baffles and gates as the concrete was dumped. The slump was but 3", but the concrete could be placed as rapidly as a sloppy mix. There was a loss of slump of not more than ½ in. from plant to job. The concrete was mixed in 2¼ yd. batches for 1½ minutes.[N5]

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N *Roads and Streets*
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2. Taking Soil Samples by the Soil Tube Method. By O. J. Porter. Pp. 64-69, 85.
3. Roadside Mowing. Pp. 75-77.
4. Figuring Aggregate Costs. By A. B. Johnson. Pp. 79-81.
5. Concrete Haul Without Agitation. Pp. 83-85.
6. Better Equipment Will Mean More Economical Road Building. By Charles M. Upham. Pp. 94, 107.

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1. Gravel-Spreading Cost Reduced by Use of Tractor Scrapers. Pp. 76-77, 120.
2. Parking Meters as an Aid in Traffic Control. By Henry James. Pp. 87-89.
3. Calcium Chloride as a Compaction Aid in Gravel Base Construction. By J. A. Knight. Pp. 90-93, 130.

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5. Experimenting With Rubber Base Jointing Materials on Oshawa Highway. Pp. 81-82, 118.

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1. 2-Way Radio Expedites Traffic on San Francisco-Oakland Bay Bridge. By Fred E. Ebel. Pp. 21-23.
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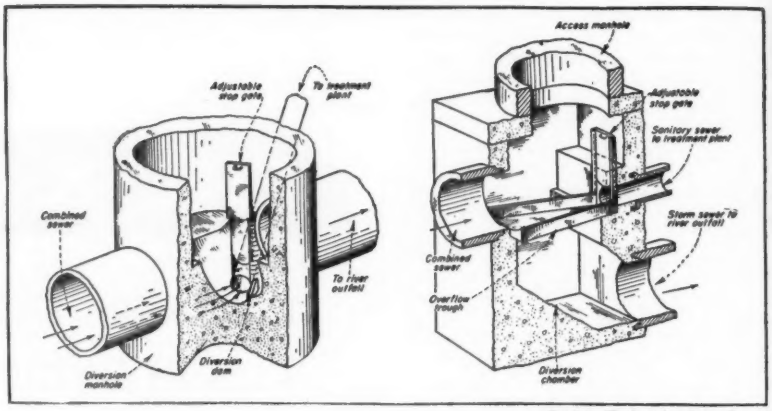
The Sewerage Digest

Diversion Factors For Combined Sewers

In diverting, from storm flow in combined sewers, that part which will be carried to the treatment plant while the rest is discharged into the diluting stream, there are two points of view—not to overload the treatment plant or design an unnecessarily large plant, and on the other hand not to discharge into the stream more than it can absorb without harmful pollution. The latter is the more important one; and the solution of it is the aim of a study made by the authors in connection with designing a system for Indianapolis.

During heavy rains the volume of storm water is many times that of the sanitary sewage and it contains sufficient oxygen to more than meet the demands of the latter. On the other hand, during light rains the combined flow might be seriously polluting. A rational method was devised for determining the diversion factor by balancing the organic load of the sewage against the purifying power of the stream. The former equals its 5-day B.O.D. multiplied by the average dry-weather flow. The latter depends upon the volume of flow, deoxygenation and re-aeration characteristics, B.O.D. and D.O. content, above the diversion chamber outlet. This is determined for the system as a whole and an overall diversion factor computed. Such calculation is made for a number of storm intensities and that which gives the highest factor is used. Individual factors for each chamber are found by multiplying the general diversion factor by the ratio of B.O.D. in ppm at that chamber to the weighted average B.O.D. of all the sewage.

Diversion chambers should be designed with a means of adjusting the overflow so that changes in population can be accommodated. Suggestions for chambers are shown in the accompanying illustration. The interceptor should be able to handle the maximum anticipated population, with a factor of at least 1½.[E1]



Courtesy Engineering News-Record

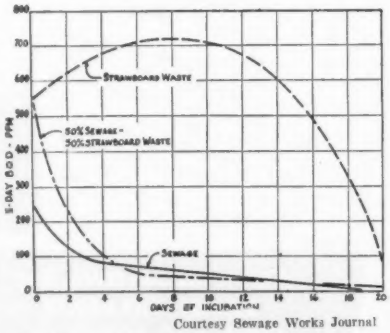
Two types of adjustable regulators for sewage diversion.

Treatment of Strawboard Waste

The Pulp, Paper & Paperboard Industries have, since 1945, been carrying out, through the National Council for Stream Improvement, a study of the characteristics of strawboard waste and methods of treating it, with means of recovering and profitably utilizing the material in it if possible. Some of the more important results of these studies to date are described in this paper. The samples studied in the laboratory were obtained from eight strawboard mills in the Midwest. These averaged 3,835 ppm total solids, 2,611 ppm volatile solids, 1,707 ppm suspended solids, and 847 B.O.D., the B.O.D. values ranging from 525 to 980.

A study of the nitrogen, phosphoric acid and potash content suggested that the concentration of nitrogen-bearing salts is too low for the satisfactory biological treatment of strawboard waste.

The character of the particles of strawboard waste makes it important that tests for suspended solids be run by identical methods to obtain comparable results. Between 50 and 63 per cent of strawboard waste suspended solids can be removed on settling for one hour. Concentrations of these settled solids have been found to vary from 2.0 to 2.8 per cent. Forty-seven per cent of the strawboard waste B.O.D. is in a dissolved state. The organic matter in strawboard waste appears to be oxidized at a rate comparable to that of sewage when supplemented dilution water is used. Tests on the reduction of B.O.D. indicate that the rate of reduction in mixtures of sewage and strawboard waste is more rapid than in either sewage or strawboard waste alone.[C7]



Courtesy Sewage Works Journal

Sewage and strawboard waste mixes and effect on BOD reduction.

Trickling Filters At South St. Paul

The treatment plant at South St. Paul, in operation since 1940, contains screens, grit chambers, roughing tanks, grease removal units, mechanical flocculation, primary sedimentation, primary trickling filters and final sedimentation. There are 6 circular 113-ft.-diam. filters with an average rock depth of 6 ft. Over 90% of the flow is waste from packinghouses (which pay 90% of the operating expenses, the other 10% being raised by a sewer rental charge of 15% of the water bills). During killing days the flow varies from 5 to 17 mgd, the maximum solids contents may be 25 times the minimum hourly, for that day, or 100 times the Sunday minimum. It was feared that these high quantities and extreme variations would cause ponding, and each filter is equipped with backwash facilities and with air lines at the bottom for agitating the wash water. For backwashing, 450,000 gal. of plant effluent is used for each filter, drawn from an elevated tank into which it is pumped. This tank gives a hydrostatic pressure of 6.3 to 4.7 lb. and a flow up through the filter at 15,000 gpm. Air is forced in at

3 lb. pressure at 6,500 cfm. Experience has shown that much better results would be obtained if the hydrostatic pressure were increased 3 or 4 lb. and more air were supplied at greater pressure. The wash water is drained into a storage tank, from which it is bled back to the raw sewage during the night. The sewage going on the filters has an average B.O.D. of 551 ppm, of which 314 ppm are removed by the filters and final settling tanks.

The filters are not housed and none has frozen, although, during wind storms, ice collects on the distributor guide cables and the filter walls. The latter is almost completely eliminated by raising the hinged diffuser plates on the nozzles nearest the wall, causing the sewage there to flow in a steady stream instead of a spray.[C9]

Effect of Nitrification on B.O.D.

In determining BOD of activated sludge or trickling filter effluents when in a stage of active nitrification, high values may be found resulting from nitrogenous oxidation which has superimposed itself over the small residual carbonaceous BOD remaining in the effluent. Studies of this phenomenon showed that:

(1) Active nitrification adversely affects the B.O.D. values of activated sludge and trickling filter plants and of streams in a state of high stabilization. Such values may result in misinterpretation of the degree of treatment or of the stability of the water of a stream.

(2) Correction of these conditions is feasible by use of the modified method of determination of B.O.D.

(3) Either pasteurization and seeding or acidification, neutralization and seeding may be used to nullify the effect of nitrification in oxidized effluents and stream samples.

(4) Acidification has the advantage of simplicity of manipulation and precedent.

(5) Acidification can be used as a preservative for B.O.D. samples in the field.[C4]

Oxidation of Sulfur Compounds

The sulfate content of domestic sewage may be as high as 200 to 300 ppm in some regions and as low as 30 to 40 in others. Little is known as to the effect of sulfur compounds on sewage treatment processes and the relative rates of oxidation of the various surfur compounds. This paper reports on studies of the rates of oxidation of a number of reduced inorganic sulfur compounds simulating the conditions of aerobic treatment. Of the compounds used, thiosulfate is the only one that cannot be oxidized without bacteria.

The results show that (1) Fresh domestic sewage contains an appreciable quantity of reduced sulfur compounds. (2) These compounds, native to fresh domestic sewage, are oxidized completely by aeration whether under sterile or non-sterile conditions. This characteristic suggests that the reduced sulfur compounds in sewage are not organic in nature. (3) The artificially added sulfur compounds (with the exception of thiosulfate) were readily oxidized in sewage under sterile conditions. (4) The rate of oxidation was enhanced in the presence of the biologically active flora of activated sludge and trickling filter slime. (5) The rate of oxidation of sulfur dioxide was the lowest of all the compounds tested under the conditions of the experiment.[C3]

Sewer Maintenance In Small Cities

If sewers have been well laid, once-a-year cleaning is generally sufficient; which may consist only of flushing and dragging through it a coil or brush or both. Well kept daily records of the maintenance crew will show where the troublesome spots are and indicate the cause and generally also the remedy. One cause of deposits is too flat slopes; these can be avoided by use of lift stations, which if well designed, may be less expensive to operate than would be the frequent cleaning of the flat sewer they eliminate. In laying sewers, the old sand-cement joint should never be used; there are several asphalt, tar and

sulfur-base compounds that give tight joints if properly used. Special attention should be given to connections between house services and mains; at Turlock, Calif., these are the most vulnerable spots in the whole system so far as tree roots are concerned. At Fresno, Calif., hot-pour compounds are found not to adhere to sewer pipes if they are even moist, unless they have previously been primed when dry.[C10]

Operation of a 2-Stage Biofilter

The filters at Liberty, N. Y., are operated as a 2-stage biofilter in summer, and as a straight trickling filter during the late fall, winter and early spring, when the contributing population is much less. The design was based on a loading of 3.1 lb. of raw sewage BOD per cu. yd. of filter medium. Records of six years of operation have been studied and disclose some interesting facts. One of these is that the percent removal of BOD varies directly as the strength in ppm of the primary tank influent, which varied from 175 to more than 800. The average removal for influents containing over 450 ppm BOD was 62%, and the percentages decreased in practically a straight line to 30 for influents averaging 215 ppm; the figures being for periods when recirculation was not employed. With the weaker influents, diluted with returned primary effluents, the percentages ranged from 47 for an average of 420 ppm to 27 for 170 ppm.

During the winter the two filters are used in parallel as straight trickling filters without recirculation. The two are alike in all respects except as to size of stone, the stone in the one used as primary filter being 2½" or larger, that in the secondary 1½". For two winters the loadings on both were presumably the same, 0.77 lb of BOD, and both were operated in the same way; average removal by the primary filter was 0.36 lb. and by the secondary 0.24 lb. per cu. yd.[P1]

High-Rate Filter Recirculation

The high-rate trickling filter plant at Salinas, Calif , contains a primary sedimentation tank; a trickling filter 80 ft. in diameter with 3.2 ft. depth of rock 2" to 4" in size, a 4-arm distributor, clay block underdrains, with a 6" ventilation opening around the entire bottom of the filter wall; a secondary sedimentation tank; and a recirculation sump and two 1,000 gpm pumps. There are also provisions for chlorinating, digesters and sludge drying beds. The sewage treated is strictly domestic, from 9,000 population. Last year tests were made to compare two methods of recirculating the filter effluents. The applied loading to filter was about 1.40 lb. of BOD per cu. yd. of rock by primary sedimentation tank effluent only, or 1.92 with recirculation water added. During a week in June the recirculation was through the secondary sedimentation tank; during a week in September the filter effluent was recirculated directly from the filter without settling. During the former week the BOD was reduced from 282 to 23; during the latter week, from 276 to 27. A study of the analyses showed that:

1. The averages of each of the seven-day tests show a marked uniformity for all tests of the raw sewage.

2. A comparison of the two methods of recirculation indicates only slight differences in overall reductions from raw to final effluent. There is a greater difference when the final effluents only are compared.

3. The overall reduction of ninety per cent for both the BOD and suspended solids is excellent for a single-stage trickling filter and again satisfactorily demonstrates its value for secondary treatment of sewage.[H3]

Hog Feeding Vs. Garbage Grinding

Canton, Ohio, finds it necessary to rehabilitate its sewage treatment plant, built in 1914. The old plant was located 6 miles from the city and the sewage is stale and odoriferous when it reaches there, and the outfall sewer has insufficient capacity; therefore the consulting engineers recommend building an activated sludge plant within city limits and onto a city ent practi At pres bage once charging produced lecting, c $106,000. $10,000 The engi garbage a the treatm correspon 1960 this ly; that s cost $17 $135,000 indicates bined dis tage of el jectionabl

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limits and pumping the digested sludge onto a city-owned farm, as is the present practice.

At present the city collects the garbage once a week and feeds it to hogs; charging for this service at a rate that produced $116,000 in 1944; while collecting, can cleaning and disposal cost $106,000. With increasing costs, the $10,000 profit will probably disappear. The engineers recommend grinding the garbage and adding it to the sewage in the treatment plant and enlarging this correspondingly. They estimate that in 1960 this would cost $297,800 annually; that sewage treatment alone would cost $173,000 and the hog feeding $135,000, or a total of $308,000. This indicates a saving of $11,000 by combined disposal, with the added advantage of eliminating the aesthetically objectionable hog farm.[J1]

Brass Wastes And Sludge Digestion

At Kenosha, Wis., the American Brass Co. has been discharging into the city's sewers its oil and copper-bearing wastes, which are toxic to sludge digestion. The sewers receiving these wastes carry 35 to 40% of the city's domestic sewage and, to protect the treatment plant, all of this has been discharged directly into Lake Michigan without treatment. In 1946 that company agreed to eliminate their copper-bearing wastes from the city's sewers and to build an 18" sewer to carry them directly to the lake. Then all of the sewage will be treated at the city's sewage plant. The oil-bearing wastes from that company's plant will continue to be discharged into the sewerage system with the understanding that, should they be found to be detrimental to the operation of the plant, further arrangements will be discussed.[H4]

Sludge as a Biozeolite

Among the theories as to the functioning of the activated sludge process is one that the activated sludge is a base-exchanging substance chemically identical with the zeolites used in water softening. Experiments were conducted at Baltimore's Back River treatment plant to investigate this, using raw, digested and activated sludges. It was found that all the sludges removed ammonia from sewage, their ability decreasing in inverse proportion to the amount removed. All the sludges could be reactivated many times with sodium chloride. Raw sludge was the most effective in removing ammonia, activated sludge the least.

The inorganic residues remaining after all of the volatile solids had been driven off from the three sludges were about equally effective in removing ammonia. The presence of comparatively small amounts of volatile matter considerably increased the amount of ammonia removed. The ability to remove ammonia resided more in the volatile material than in the fixed solids.

The removal of only 100 to 125 mg. of ammonia from sewage per 1,000

grams of solids (0.1 to 0.125 lb. per 1,000 lb.) indicates that the action of activated sludge as a zeolite is of negligible value. By the time raw sewage solids enter aeration tanks, they frequently have been in contact with the sewage for hours and will have taken up most or all of the ammonia possible. No doubt as these solids pass through the aeration tanks they become more finely divided by the agitation of air. New interfaces are thus produced between the solids and the sewage, permitting a base exchange of ammonium ions.

If it is assumed, however, that the suspended solids entering an aeration tank exclusive of the return activated sludge (this material will have taken up all the ammonium ions possible during its previous passages through the aeration tanks) amounts to 150 p.p.m., and each 1,000 lb. of these solids can remove 0.125 lb. of NH_3, 0.156 lb. of NH_3 per million gallons of sewage or 0.02 p.p.m. would be removed. As the amount of NH_3 normally removed by the activated sludge process varies from about 10 to 20 p.p.m., it is apparent that the removal of ammonia is largely due to causes other than a base-exchange reaction.[C2]

Amsterdam's New Incinerator

Amsterdam, N. Y., has just installed an incinerator to take the place of a garbage dump which was a source of smoke, odors, rats and flies. The population is about 40,000. The anticipated load of garbage and rubbish is 35 tons per day, and the incinerator has a capacity of 120 tons in 24 hr. with a view to burning all the refuse in the day shift and providing for growth of the city. The incinerator also receives the refuse from a nearby village of 933 population, for which a charge is made of $4.50 for a 1½ ton truck load. The cost was about $260,000. The incinerator was placed on a sloping hill side, making possible three separate levels, for dumping and charging, for stoking, and for ash removal. Each of the two units is provided with a forced draft fan. The ash removal floor has two ash tunnels, permitting trucks to back under the ash hopper to receive the incombustible residue.[P1]

Synthetic Detergent Causes Foaming Tanks

One Tuesday morning a few weeks ago the aeration tanks at the disposal plant of Mt. Penn, Pa., became covered with a blanket of white suds 2 to 5 ft. thick. Consulting engineers called in to ascertain the cause believed that it was caused by the use of a "soapless soap" or synthetic detergent by many families in their Monday washing. The company making this had distributed free samples of it to every home in town the previous week and probably most of them used it the next Monday, many of them at double the dose recommended. The company accepted this theory and supplied a defoaming agent that would eliminate the foam if applied to the tank.

The engineers found that this foam leaves a thick grease on the walls of the tank, produces a poor condition in the activated sludge, carries through the entire treatment plant, and that the final effluent carries a white foam into the receiving stream.[J3]

The Esholt Words of Bradford, England, treat sewage which contains a large precentage of wool scouring wastes. Recently a problem has arisen which, due to shortage of soap, may become serious in the future, *i.e.*, that arising from the use of various synthetic detergents which are now being experimented with in the textile trades, both in raw wool washing and in the scouring of the cloth. Various products containing these synthetic detergents are also being put on the market for domestic scouring operations. These liquors are not amenable to an acid precipitation, although when mixed with soaps in sewage some "cracking" of a physical as opposed to a chemical nature takes place. On the whole, however, the liquors are more colloidal, contain more grease and, of course, provide a stronger liquor for subsequent biological purification.[D2]

When you need special information—consult the **ENGINEERS' LIBRARY** *on pages 63-65*

Automatic Control of Chlorination

For chlorinating the effluent from Los Angeles' Hyperion plant, W&T chlorinators are provided which have a capacity of 21 tons of chlorine per day. The dosage averages 18 tons and is controlled automatically so that exactly the desired rate of dosage may be maintained 24 hr. a day. The heart of this control is a clock to which are fixed disks permitting a variation in the rate of chlorination, time period for priming and flushing, and time on-the-line for each of seven units. Electrically heated evaporators convert the liquid chlorine into the gaseous state. Should the temperature of any unit be too low, a red light glows on the control board.

Bibliography of Sewerage Literature

C *Sewage Works Journal*

November

1. Developments in Sewage Disposal for San Francisco. By Clyde C. Kennedy. Pp. 963-979.
2. Sewage Sludge as a Biozeolite. By C. E. Keefer. Pp. 980-988.
3. Oxidation of Reduced Sulfur Compounds in Sewage. By H. Heukelekian and Ruby Lassen. Pp. 989-994.
4. Nitrification and B.O.D. By E. Hurwitz, G. R. Barnett, R. E. Beaudoin and H. P. Kramer. Pp. 995-999.
5. Factors Affecting the Direct Oxygen Utilization Method. By Lloyd L. Falk and Willem Rudolfs. Pp. 1000-1006.
6. The Treatment of Cyanide Wastes by Chlorination. By John G. Dobson. Pp. 1007-1020.
7. Characteristics of Strawboard Waste. By Don E. Bloodgood and George Erganian. Pp. 1021-1031.
8. Natural Purification Characteristics of a Shallow Turbulent Stream. By F. W. Kittrell and O. W. Kochtitzky, Jr. Pp. 1032-1049.
9. Sewage Treatment at South St. Paul, Minn. By W. H. Cropsey and K. D. Larson. Pp. 1051-1060.
10. Sewer Maintenance in Small Cities. By Don C. Davis. Pp. 1065-1072.
11. Interesting Extracts from Operation Reports. By Le Roy W. Van Kleeck. Pp. 1072-1079.

D *The Surveyor (England)*

November 14

1. Private Sewers. By L. B. Escritt. Pp. 591-593.

November 21

2. Some Future Problems in Sewage Purification at Bradford. By C. C. Beedham. Pp. 611-615.

November 28

3. Damage to a Birmingham Sewer by Sulfation. By D. G. Bevan. Pp. 621-622.

E *Engineering News-Record*

November 27

1. Diversion Factors for Combined Sewers Based on Sewage and Stream Analyses. By Robert J. Theroux and Robert L. Meek. Pp. 56-58.
2. New Standards for Perforated Pipe. P. 58.

December 11

3. Chlorination Curbs Beach Pollution. Pp. 105-107.
4. Sewer Gate Operation by Remote Control. By L. L. Bradish and F. C. Lorenzen. Pp. 116-117.

G *Water and Sewage Works*

November

1. Public Relations Program Pays Off. By W. M. Kunsch. Pp. 424-426.
2. Proposed Water Pollution Legislation. By M. Le Bosquet, Jr. Pp. 427-430.
3. A Simplified Vacuum Filter. By T. R. Komline. Pp. 431-432.

H *Sewage Works Engineering*

December

1. Growing Pains of a Sewage Treatment Plant. (San Antonio, Tex.) By E. J. M. Berg. Pp. 616-619, 636.
2. The Plant Operator Has Responsibilities. By Francis S. Friel. Pp. 620-621, 640.
3. Recirculation Tests on a High-Rate Filter. By Clyde C. Kennedy and Walter C. Roberts. Pp. 622-624.
4. Brass Wastes Detrimental to Digesters at Kenosha, Wis. By H. T. Rudgal. P. 626.
5. Operation of Sludge Drying Beds. Pp. 630-632.

I *Municipal Engineering (England)*

November 7

1. Pollution of Rivers by Sewage. By L. J. A. Stow. Pp. 251-252, 256.

November 21

2. Treating Wool Trade Effluents at Bradford. Pp. 276-277.
3. Future Disposal Works of the Birmingham Tame and Rea District. By F. C. Vokes. P. 278.

J *American City*

December

1. Garbage-Sewage Treatment. Pp. 82-83, 96.
2. A Refuse Dump Doesn't Have to Smell. By Rolf Eliassen. Pp. 92-94.
3. What Caused the Suds in the Sewage Treatment Plant? P. 99.

P *Public Works*

December

1. 2-Stage Biofilter Operation (at Liberty, N. Y.). Pp. 24-25, 55.
2. A Modern Incinerator for Amsterdam, N. Y. By B. A. Kroup and R. S. Taggart. P. 26.
3. Factors in the Design of Model Waste Treatment Plants. Pp. 29, 30.

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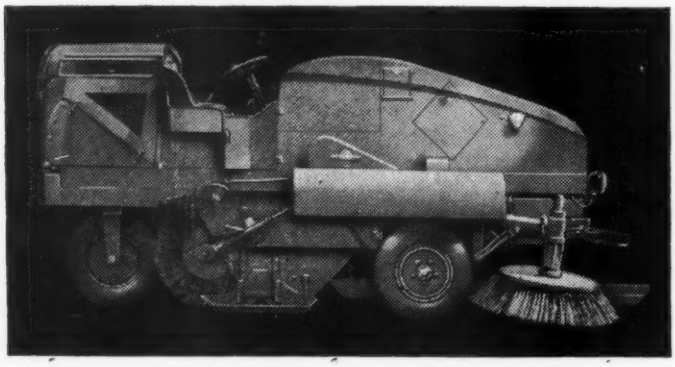


The Wayne Motor Sweeper.

For Cleaner Streets at Lower Cost

A pick-up type sweeper of modern streamline design claims three distinct advantages: First, the atomizing spray system which prevents the formation of mud which might adhere to the brush or the pavement; second, easily adjusted broom pressure to insure maximum sweeping efficiency under all conditions; and, third, pick-up broom guards and shoes which prevent dirt passing around the ends of the broom and do not leave ridges of unswept material. Turning radius is 14 ft. An instructive and well-designed folder describes the unit. Write *Wayne Motor Sweeper, 4900 Santa Fe Ave., Los Angeles 11, Calif.*

Many Uses for This 2-Wheel Tractor

This is a 2-wheel power tractor with a 3-hp. motor which is designed for mowing, plowing snow, cultivating or leveling ground, and many other services. A riding attachment is available; also a smaller size unit. Catalogs available from *Bolens Products Division, Port Washington, Wisc.*

Curb and Gutter Construction by Machine

Here is something new, and something with the ability to rid curb and gutter construction of much of its worries and delays. It makes curb and gutter construction possible as quickly as any other phase of street and road work. It will build 5 to 10 lineal ft. per minute. It will build combined curb and gutter, integral curb, or highway lip curb and can be used for street widening. On curb work various shapes of curb and gutter are possible by changing the screed, strike-off and finishing trowel. A standard curb height can be maintained with varying thicknesses of gutter. The machine will fit any standard form now used by cities, states, counties and contractors. For full data, write *Dotmar Industries, 503 Hanselman Bldg., Kalamazoo 1, Michigan.*

Lightweight ⅜-Yard Shovel, Drag, Clam and Hoe

This ⅜-yd. shovel, dragline, clamshell, crane and hoe is designed for the smaller jobs that are so numerous in city and county work. Its design allows satisfactory use in shallow cuts and assures maintaining grade in them. It is available in either diesel or gas power. The cab gives full view of the work and complete weather protection. For illustrations and data write *Osgood Co., Marion, Ohio.*

Clinton Engine Weighs 47 Pounds

A 2½-3-hp. gasoline engine suitable for many applications weighs only 47 pounds. It is 4-cycle, single-cylinder, air-cooled, with muffler and governor

Lightweight Clinton Engine.

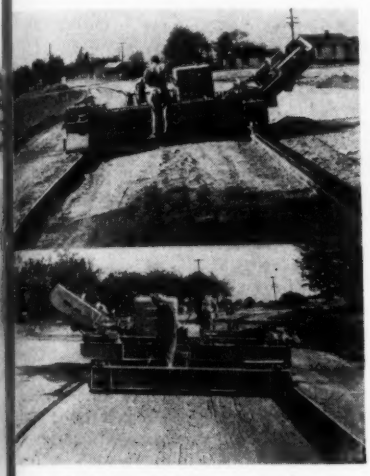
It is available with special mounting bases. A folder describes this 110 series Clinton engine, and states that after run-in, engines will develop not less than 95% of rated bhp. Engine power will decrease 3% for each 100

The Dotmar curb and gutter construction machine.

ft. above sea level and 1% for each 10°F above 60°. Operation is at 3000 rpm. *Clinton Machine Co., Clinton, Mich.*

Vibratory Subgrader Lowers Subgrade Cost

Using the principle of vibration, a revolutionary type subgrader has been developed, which speeds the work and, with lower power consumption, will cut through the hardest soil materials. It will produce accurate grade, true to crown and cross section, and the crown can be adjusted to flat and back to crown again, as required, without stopping the machine. Final shape to the subgrade is provided by a two-wheel strike-off, adjustable for crown, which is towed behind the machine. Provision is made for filling any small hole or irregularity in the subgrade. For information on this "precision" subgrader, write *Blaw-Knox Co., Pittsburgh, Pennsylvania.*



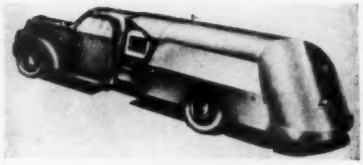
Blaw-Knox vibratory subgrader.

Streamlined Street Flusher With Many Uses

In addition to street flushing, this stream-lined street flusher will fight fires, clean sewers, spray trees and shrubs and pump out basements. It is built in 1,200, 1,600 and 2,000-gal. capacities, and equipped with all of the facilities for easy operation—one master directional flow control valve, ample flushing pressure at the nozzles, wrought steel pipe throughout, and carefully distributed weight. Full information from *Rosco Mfg. Co.*, 3118 *Snelling Ave., Minneapolis 6, Minn.*

Mower and Jeep or Tractor Combination

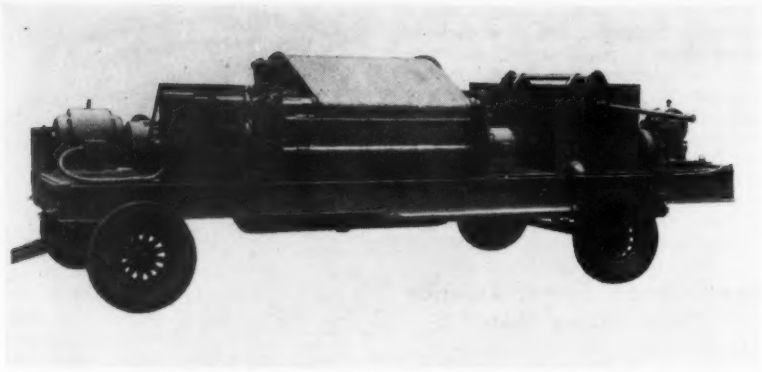
This is a mowing machine to be attached to the front end of a four-wheel tractor or a Jeep. The mower is powered by a direct drive from the power take-off and operates about 5 ft. in front of the vehicle, so that the operator can see the mower working. Attachment may be made in center position, to cut directly ahead of the tractor; or so as to cut to either side. Cutter bar is 6-ft. It takes 1½ hours to make the original attachment, and 5 minutes to attach or detach thereafter. Write *Turner of Indiana, Inc., Indianapolis, Ind.*



Rosco streamlined flusher.

Rubber Coating for Concrete Pipe

A synthetic rubber coating provides complete protection for concrete pipe against either inside or outside agents. This coating is not a paint film; it is applied cold and penetrates deeply, vulcanizing to the surface on which it is applied. It is unaffected by practically all industrial acids or alkalies; mineral or organic oils; or sunlight. It has no moisture absorption and is unaffected by heat up to 375°F. For fuller information and results of tests with various acids and alkalies, write *Hamilton Kent Mfg. Co., Kent, Ohio.*



Trailer-mounted sludge dewatering demonstration unit.

Sludge Dewatering Demonstration Unit

A trailer-mounted unit to demonstrate the possibilties and advantages in the use of the cord filter for dewatering sewage sludge and industrial wastes has been constructed by the Komline-Sanderson Engr. Corp. of Ridgewood, N. J. The unit consists of a 4' x 4' filter, equipped with a sludge pump, coagulant mixing tank, vacuum pump and coagulant mixing pumps. This type of filter has operated continuously, without clogging, under tests. Demonstrations of the unit, which include actual work on your own sludge problem, can be arranged with the above company.

Explosion Proof pH Meter

This is an explosion-proof, line operated, direct reading, continuous indi cating pH meter. It is designed for use in atmospheres containing gasoline, methane, sewer gas, etc. A connection permits the recorder to be placed at a remote location. Full information from *Macbeth Corp., 227 West 17th St., New York 11, N. Y.*

Combination Truck Body Has Many Uses

This truck body is made in 9, 11 and 13-ft. lengths, and is adapted to hauling rock or gravel as a center-dump body. It is also equipped with a spreader for spreading fine material, as lime, over a strip 30 ft. wide. Full information from *Weston Dump Body Co., 326 S. W. 11th St., Des Moines, Iowa.*

Proportioneer Trailer Travels

The Proportioneer trailer, which many inspected outside the convention hall in San Francisco at the AWWA-FSWA convention, has since gone to Portland, Seattle, back through San Francisco to Los Angeles, Texas and Oklahoma with various side trips throughout the territories covered. The trailer will leave Houston this month and will cover Louisiana, Mississippi, Alabama, Georgia and Florida, with the expectation that it will return to Providence in the spring. Sales engineers from the office are "being exiled" regularly for trailer piloting and training.

Two-way FM Radiotelephone Helped in Maine Fires

Motorola field engineer Ralph F. Anderson has been commended by officials of the State of Maine for his assistance in the recent fire emergency there. The 2-way radio system was used to direct the activities of the law enforcement division, to maintain contact with remote communities, and to direct fire-fighting activities.

INDUSTRIAL ITEMS

The Michigan office of the Clay Sewer Pipe Association has been moved to 610 Eddy Building, Saginaw, Mich. C. J. Bauer is resident engineer.

Syntron Co., Homer City, Pa., has established a branch sales office at 4695 Sherbrooke St., W, Montreal, Canada, with F. A. Gray in charge. Syntron has also purchased the former H. K. Porter Co. plant at Blairsville, Pa., adding 2½ acres of modern manufacturing facilities. D. G. Black is general sales manager of Syntron.

Economy Pump Co., Hamilton, O., has acquired from the War Assets Corp. the war-time addition built to its plant by the DPC. This adds 2½ acres of floor space.

Barber-Greene Co., Aurora, Ill., has appointed Capitol Equipment Co., Inc., Troy, N. Y., and Hooper Engrg. Co., Skeneateles, N. Y., as equipment distributors.

B. A. Schimmel has been appointed sales manager of the Wood Mfg. Co., North Hollywood, Calif.

A. F. McCormack has been appointed sales engineer in charge of Permutit Company's newly established Rochester office (119 Main St., E), which office replaces the Syracuse office, now closed, which was formerly directed by F. D. West, who has retired after 29 years of service with Permutit.

H. W. Vine has been appointed Manager of Industrial Sales for the Gorman-Rupp Co., pump manufacturers, Mansfield, Ohio.

BOOKLETS

Jeffrey Research Center. — This 6-page brochure will be of interest in showing what one company is doing in the line of research. The new Research Center is described and illustrated. Jeffrey Mfg. Co., Columbus 16, O.

Improved Perforated Clay Pipe.— A 4-page folder, with information about and dimensions of standard-strength and extra-strength perforated clay pipe. Clay Sewer Pipe Association, Huntington Bank Bldg., Columbus, O.

This is the new Lessman power shovel. For description see December Public Works, pages 66 and 67. It digs, carries and loads on most any kind of city or county work.

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Have You a Deep Well Pumping Problem?

455. Peerless deep well pumps in a variety of types, with oil or water lubrication and any power drive, to pump water from any depth are subject of special bulletins. Write Peerless Pump Div., Food Machinery Corp., 301 W. Ave. at 26th St., Los Angeles 31, Calif.

Won't a Small Tractor Help You?

551. If your problem calls for a snow plow-grader or a power mower, Gardenaid Tractors provide an efficient, economical solution. For full data write Dept. PW, Eastern Tractor Mfg. Corp., Kingston, N. Y.

New Ideas in Economical Swimming Pool Designs

552. Bintz Pools, a combination pool and bathhouse, saving 25-40% in cost with a dozen advantages over the conventional sunken pool and bathhouse; and Ovoid Pools, saving 100% with 4 or 5 advantages over the conventional rectangular pool field by Wesley Bintz, Consulting Engineer, Civil, Swimming Pool Designs, Park Layouts, Memorial Buildings and Allied Structures exclusively, 301½ S. Washington Ave., Lansing 25, Mich. Complete information on request.

Power Mower for Water Works, Sewage Plants, Highways, Etc.

553. For cutting the grass around your Water and Sewage plants and removing weeds and tall brush along your highways the Jari power scythe is just the thing you need! For a booklet describing this mower which is said to be easy to handle, economical to operate, fast and clean around trees and can be handled by one man write Dept. PW, Jari Products, Inc., 2936-F Pillsbury Ave., Minneapolis 8, Minn.

Are You Looking for New Or Reconditioned Valves or Pumps

559. A 16 page bulletin listing all types and makes of new and reconditioned valves and pumps is now available on request from Sonken Galamba Corp., Second and Riverview, Kansas City, Kans.

Diesel Engines to Help You Build Profits

560. A new 28 page catalog just off the press titled "Superior Stationary Diesel Engines," is packed with facts that will help you build profits. For your copy write to Superior Engine Division, National Supply Company, Springfield, Ohio.

Need Low-Cost Air For Sewage Treatment?

602. New booklet on Centrifugal and Rotary Positive Blowers engineered to fit your needs: air for activated sludge; constant vacuum for filters; priming centrifugal pumps; measuring sludge gas; water treatment. Write Roots-Connersville Blower Corp., 712 Poplar Ave., Connersville, Ind.

CONSTRUCTION MATERIALS AND EQUIPMENT

These Wheel Tractors Solve Many Hauling Problems

4. Specifications and full information about the new M-M wheel tractors in sizes 27 HP to 49 HP. Send for copies today. Dept. PW, Minneapolis-Moline Power Implement Co., Minneapolis, Minn.

Solve Your Drainage Problems This Easy, Permanent Way

70. Useful new 60 page catalog on standard corrugated pipe, multi-plate pipe and arches and 18 other drainage and related products for culverts, sewers, subdrains, flood control, airports, water supply and other types of construction. Ask for "Armco Products for Engineering Construction." Armco Drainage and Metal Products, Inc., Dept. PW Middletown, Ohio.

Improve Appearance of Curbs, Gutters, Sidewalks

78. Curb and Gutter and Sidewalk Forms, including battered face curb form especially for modern traffic conditions. Last 20 years or more. Send for new engineering data Bulletin A-20-F, Dept. P.W., Heltzel Steel Form & Iron Co., Warren, O.

Reliable Every Purpose Pumps

117. New brochure by Gorman-Rupp Co., Mansfield, Ohio, illustrates and describes many of the pumps in their complete line. Covers heavy duty and standard duty self-priming centrifugals, jetting pumps, well point pumps, triplex road pumps and the lightweight pumps.

Strong, Speedy, Low-Cost Maintainer Has Many Uses

130. BG Maintainer, a powerful speedy, low-priced machine for light road maintenance. Full details in illustrated folder. Huber Mfg. Co., Dept. P.W., Marion, Ohio.

Have You Floor Troubles?

550. Stonhard Company has the answers for rough, rutted concrete or wood floors. 48-page booklet tells all about how to resurface them without calling in outside help. Address: Stonhard Company, 883 Terminal Commerce Bldg., Philadelphia 8, Pa.

SNOW FIGHTING

For High-Speed Snow Removal

350. "Frink One-Way Sno-Plows" is a four page catalog illustrating and describing 5 models of One-Way Blade Type Sno-Plows for motor trucks from 1½ up to 8 tons capacity. Interchangeable with V Sno-Plow. Frink Sno-Plows, Inc., Clayton, 1000 Islands, N. Y.

STREETS AND HIGHWAYS

Mix-in Place Roadbuilders Save on Scarce Labor

187. Mix-in Place Roadbuilders. Bituminous Pavers, Concrete Bituminous Finishers. Adjustable Spreaders, Forms, etc. —4 complete catalogs in one cover, issued by the Jaeger Machine Company, 400 Dublin Ave., Columbus 16, Ohio.

Here's Your Diesel Tractor!

190. Big 48 page catalog describes and lists many uses for International Diesel Tractors. Write International Harvester Co., Dept. P.W., 180 North Michigan Ave., Chicago 1, Ill.

SEWAGE DISPOSAL

Non-Corrosive, Long Lasting Low Cost of Sewer Pipe

72. Get this new engineering data on clay pipe for sewers. Withstands acid, alkali and gas attacks indefinitely. Cuts maintenance costs to a minimum. Write Dept. P.W., National Clay Pipe Mfrs., 111 W. Washington St., Chicago 2, Ill.

Valuable Booklet on Porous Diffuser Plates and Tubes

367. A valuable booklet on porous diffuser plates and tubes for sewage treatment plants. Covers permeability, porosity, pore size and pressure loss data, with curves. Also information on installations, with sketches and pictures, specifications, methods of cleaning and studies in permeability, 20 pp. illustrated. Write to Norton Company, Dept. P.W., Worcester 6, Mass.

How You Can Clean Sewers From Streets Easily and Inexpensively

386. 32-page illustrated booklet explains how a city can clean its sewers and culverts with its own forces using the up-to-date Flexible Sewer Rod equipment. Illustrates and describes all necessary equipment. Issued by Flexible Sewer Rod Equipment Co., 9059 Venice Boulevard, Los Angeles 34, Calif.

How to Make Concrete Pipe on the Job

440. Making concrete pipe on the job with local labor is the subject of a booklet sent on request by Quinn Wire & Iron Works, 1621 12th St., Boone, Ia., manufacturers of "Heavy Duty" Pipe Forms.

Concrete Pipe With Greater Elasticity

442. Lock Joint Reinforced Concrete Sewer Pipe, Pressure Pipe, Culvert Pipe, Centrifugal Pipe and Subaqueous Pipe is described and illustrated in bulletins available from Lock Joint Pipe Co., Ampere, N. J.

Save Trucks and Labor In City Rubbish Collection

459. For saving trucks, labor, and time in city rubbish collection get details of the new Dumpster-Kolector described in literature just published by Dempster Brothers, Inc., 996 Higgins, Knoxville 17, Tenn.

Packaged Sewage Treatment— Just Right for Small Places

488. "Packaged" Sewage Treatment Plants specifically developed for small communities — 100 to 3,000 population. Write for full description and actual operating data for this type of plant. Chicago Pump Co., 2348 Wolfram St., Chicago 18, Ill.

How to Stabilize Lime Softened Water

498. Engineering Bulletin describes stabilizing lime-softened water by recarbonation, discusses gas production, washing, compressing, drying, and applying the CO_2. Infilco, Inc., 325 West 25th Place, Chicago 16, Ill.

For All Sludge Dewatering

601. The first filters to be used in large scale operation on primary, elutriated and Guggenheim sludges. Ask for latest engineering Bulletin P.W. General American Process Equipment Div., 10 E. 49th St., New York, N. Y.

WATER WORKS

Hydraulic Pipeline Scraper For Water and Sewage Mains

382. For a copy of this compact folder on a hydraulic pipeline scraper which cleans all kinds of mains from 4 inches to 14 inches write to Dept. PW, Carver-Stimpson Pipe Cleaning Co., Walters, Okla.

Solve Corrosion Problems With This Special Alloy

391. "Everdur Metal" is title of an 8-page illustrated booklet describing advantages of this corrosion-resisting alloy for sewage treatment equipment, reservoir, and waterworks service. Dept. P.W., the American Brass Co., 25 Broadway, N. Y. C.

To Measure, Mix, Feed Chlorine or Other Gases

397. Everson SterElators. Bulletins 1063, 1066, 708 and others describe this device for measuring, mixing and feeding chlorine or other gases in solution. Capacities range from ¼ lb. to 2,000 lb. of gas per 24 hours. Address: Everson Manufacturing Co., 214 W. Huron St., Chicago 10, Ill.

Helpful Data on Hydrants

405. Specifications for standard AWWA fire hydrants with helpful instructions for ordering, installing, repairing, lengthening and using. Issued by M. & H. Valve & Fittings Co., Dept. P.W., Anniston, Ala.

Complete Data on Gates, Valves, Hydrants

414. Gate Valves. Double disc bronze mounted, sizes 2" to 72", hand, hydraulic, electric or pneumatic operating, rising or non-rising stem. Bulletin X. Address: Rensselaer Valve Co., Troy, N. Y.

Find Your Leaks In a Jiffy

427. For tracing buried pipes and finding hidden leaks get details of Allen-Howe Leak Detectors, Pipe Locators, Dipping Needle and Pipe Phones. Ask for new circular P.W. 6, Allen-Howe Electronics Corp., 150 Main St., Peabody, Mass.

What You Should Know About Meter Setting and Testing Equipment

431. The most complete catalog we have seen on setting and testing equipment for water meters—exquisitely printed and illustrated 48-page booklet P.W. you should have a copy of. Ask Ford Meter Box Co., Wabash, Ind.

Do You Have This Data On Cast Iron Pipe?

438. "Cast Iron Pipe and Fittings" is a well illustrated 44 page catalog giving full specifications for their complete line of Sand Spun Centrifugal Pipe, Fire Hydrants, Gate Valves, Special Castings, etc. Will be sent promptly by R. D. Wood Co., Dept. P.W., Public Ledger Building, Independence Square, Philadelphia 5, Pa.

Interesting Facts About Transite Pipe

445. Two new illustrated booklets, "Transite Pressure Pipe" and "Transite Sewer Pipe" deal with methods of cutting costs of installation and maintenance of pipe lines and summarize advantages resulting from use of Transite pipes. Sent promptly by Johns-Manville Corp., Dept. P.W., 22 East 40th St., New York 16, N. Y.

TO OBTAIN THESE BOOKLETS USE COUPON ON PAGE 63

Need a Water-Tight Pipe Joint?

449. Full information on "Hydro-Tite" jointing compound for bell and spigot pipe, together with specifications, instructions; and illustrations both on it and "Fibrex" sanitary joint packing are contained in handsome 48-page booklet. Address: Hydraulic Development Corp., Dept. P.W., 50 Church St., New York.

How to Estimate Quantity Of Joint Compound Needed

450. The uses of Tegul-Mineralead for bell and spigot pipe and G-K Sewer joint compound are described in a 16-page illustrated booklet issued by Atlas Mineral Products Co., Mertztown, Pa. Includes useful tables for estimating quantities needed.

Data on High Efficiency Well Water Systems

454. Installation views and sectional scenes on Layne Vertical Centrifugal and Vertical Turbine Pumps fully illustrated and including useful engineering data section. Layne Shutter Screens for Gravel Wall Wells. Write for descriptive booklet P.W., Adv. Dept., Layne & Bowler, Inc., Box 186, Hollywood Station, Memphis 8, Tenn.

Oil or Water Lubricated Turbine Pumps

456. Oil lubricated turbine pumps with open impellers. Five types of heads available. Specifications and illustrations in new bulletin 6930M-2 issued by Fairbanks, Morse & Co., Dept. P.W., 600 So. Michigan Ave., Chicago 5, Ill.

Want Clear, Soft, Iron-Free Water?

467. Water Softening. The use of the Spaulding Precipitator to obtain maximum efficiency and economy in water softening is described in this interesting technical booklet. Permutit Co., Dept. P.W., 330 W. 42nd St., New York 18, N. Y.

Are You Thinking About A Swimming Pool?

472. Data and complete information on swimming pool filters and recirculation plants; also on water filters and filtration equipment. For data, prices, plans, etc., write Roberts Filter Mfg. Co., 640 Columbia Ave., Darby, Pa.

Eliminate Taste and Odor From Your Water

474. Technical pub. No. P.W. 207 issued by Wallace & Tiernan Co., Inc., Newark 1, N. J., describes in detail taste and odor control of water with BREAK-POINT Chlorination. Sent free to any operator requesting it.

Treating Water With Copper Sulphate

496. "Use of copper sulphate in water treatment plants" contains valuable data on chemicals, dosage, etc. Ferri-floc Ferric Sulphate—a new, valuable booklet P.W. on coagulation for water and sewage treatment plants. Write Tennessee Corporation, Atlanta 1, Ga.

Outdoor Water Service Devices That Do Not Freeze

506. Data on anti-freeze outdoor drinking fountains, hydrants, street washers, etc., contained in Catalog L. Sent promptly on request to Murdock Mfg. & Supply Co., 426 Plum St., Cincinnati 2, Ohio.

Find Buried Pipe and Leaks

545. Finding Buried Pipe, Leaks is easy with the new Featherweight Goldak Pipe Locator. An easy-to-read illustrated bulletin tells the full story quickly. Address: The Goldak Co., 1544 W. Glenoaks Blvd., Glenade 1, Calif.

TO OBTAIN THESE BOOKLETS USE COUPON ON PAGE 63

THINGS HAPPENING

Hayse H. Black, former C. of E. officer, has been appointed associate professor of sanitary engineering at the University of Iowa; congratulations to Iowa. . . . James B. Baty, former Sanitary Corps officer, recently retired in the rank of Lt. Col., will probably succeed Bob Dixon as associate professor of sanitary engineering at Texas A. & M. next month. . . . Mark Hollis, we understand, has been appointed to succeed John Hoskins, retired, as head of the Sanitary Engineering Division of the U. S. Public Health Service. . . . Muzaffer Unsal of Istanbul, Turkey, will be the representative in that country for the Universal Concrete Pipe Machinery Co. of Columbus, Ohio.

R. Hunter Cochran has been made general sales manager of Metropolitan Paving Brick Co., Canton, O. He was on the War Production Board during the war. . . . John R. Lill, chemical engineer, has joined the staff of Liquid Conditioning Corp. . . . R. J. Nymberg, formerly of Gar Wood Industries, has been made general sales manager of Hercules Steel Products Corp., Galion, O. . . . E. A. Longenecker has succeeded as president of Le Roi Co., Milwaukee, C. W. Pendock, who has been made Board Chairman. . . . Gar Wood Industries has made Walter C. Robertson a vice-president, E. B. Hill general sales manager and R. F. Whitworth general service manager. . . . Lucien W. Mueller has been elected chairman of the Board of Directors, Albert G. Webber, Jr., president and J. W. Simpson vice-president of Mueller Co. . . . H. M. Cahill has been made sales manager of the Small Engine Dept. of the Nordberg Mfg. Co.

A survey to cover a strip about 2,000 ft. wide and 20 miles long to serve as the basis for planning a modern expressway near Harrisburg, will be made by aerial methods by Lockwood, Kessler, Bartlett, Inc., of Brooklyn. The overall engineers are Modjeski & Masters. Scale of the map will be 1 inch to 100 ft., with 2-ft. contours. . . . The 15 members of the Minnesota Federation of Engineering Societies will hold their third annual Exposition and twenty-sixth annual Engineering Convention Feb. 11 to 14 at St. Paul. . . . A 16mm. motion picture sound film showing zinc coating of water and other pipe by the hot dip galvanizing process has been announced; for information on copies, write Stuart J. Swensson, 1611 First National Bank Bldg., Pittsburgh 22, Pa. . . . Charles M. Upham of the American Road Builders' Association says that the Marshall plan will require some American road-building equipment, though as compared to the total of the plan, the amount involved will be small. To avoid shortages and price increases, he recommends careful study of actual needs.

Advertising Index